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ABSTRACT

This seminar and workbook are designed to aid librarians in planning and designing attractive and efficient libraries in light of the changing technologies of the 1980s. It is based on the premise that the electronic revolution of the 1980s will cause substantial changes in the work force, work processes, and the nature of physical layouts of libraries. Organized as a workbook, the report contains checklists and discussion within the following subject areas: libraries meeting the problems of the next two decades; work improvement/work simplification; behavioral aspects of space; the library manager's role; impact of automation on the work environment; computers and how they work (including a glossary); human factors in relation to the man/machine interface; the arrangement of space; physical planning for electronic systems; furniture; lighting and power; acoustics; and energy. Many charts, illustrations, and reprinted articles are used to clarify aspects within subject areas. A bibliography is included. (THC)

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LIBRARY AUTOMATION AND FACILITY PLANNING

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This Seminar and Workbook are designed to aid Librarians to plan and design attractive, efficient Libraries. The methods presented are not necessarily intended to substitute for professional help, especially if the scope of the work requires such expertise. However, we believe that the best clients are the informed clients -- Librarians who not only comprehend the job to be done, but all the steps along the way.

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SUBJECT AREAS

Introduction

Libraries Meeting the Problems of the Next Two Decades

Steelcase Survey

Work Improvement/Work Simplification

Behavioral Aspects of Space

Library Manager's Role

Impact of Automation

Computers and How They Work

Human Factors

Arrangement of Space

Physical Planning for Electronic Systems

Furniture

Lighting and Power

Acoustics

Energy

Bibliography

INTRODUCTION

INTRODUCTION

Appraising the 1980's

One major challenge in the 1980's will be energy management. Another will be accommodating computers and telecommunication devices without neglecting the quality of the working life. The whole decade of the 1980's in the field of business will be involved in information management. Collecting vital information and dispersing it quickly to managers or department heads is going to be a most vital job.

The new technologies are going to continue to eliminate the more routine and uninteresting office jobs by factoring them out. New machinery and work flow patterns will change the work place. Then, too, companies which have been satisfied with the old ways of doing things will have to obtain more automated and sophisticated equipment just to stay competitive in their areas of activities, and to retain and attract personnel to staff the critical functions in their offices. (Turnover among programmers is horrendous these days.)

Another challenge will be to increase employee productivity. While industrial productivity has increase by some 90% the last ten years, office productivity managed only a 0.4% gain. All the while, the white collar sector grew from 38 million to 47 million! Thus, another challenge will be to get more work done with fewer people and at lower costs. This challenge will directly put more technology to work increasing the efficiency of the office sector

It should be understood that there are at least four basic methods

to make up a lack of productivity: increase prices (causing more inflation), cut staff and facilities (throwing people out of work), accept lower profit or productivity margins (making a less effective marketplace), or adopt methods to reverse the decline. For some, the new technologies appear to be manna from heaven, offering the most palatable answer. Hopefully the new technologies will help to stablize inflation by making many processes cheaper and turning out more work. In addition, by continuing to improve upon their own prices and performance, the new technologies will become affordable to everyone -- no matter how big or small. Right now they are enriching what is currently delivered with labor saving devices that provide assistance above and beyond the basic machinery functions. For example, printers can also be paper handling devices that cut labor in half. One printer can serve several people. In the future the market will broaden so that new applications will become ever more commonplace. This last point applies to all products, even those in existence such as word processing, facsimile, copiers and the like.

Another challenge of the 1980's will be to use information systems more effectively. This will require data of excellent quality allowing management to make proper and swifter decisions. This presupposes a better trained work force which recognizes excellent data. After all, superfluous material tends to cause confusion and use memory space. The name of the game will be competition, but <u>competition in a world wide recessive economy</u> (caused by high energy prices, depletion of some natural resources and overpopulation). Managers and their staffs are going to have to do their jobs at a much higher rate of excellent

And people who are trained in information recognition and retrieval will find themselves at the forefront of the electronic revolution.

Some of the Problems of Operation

Some of the most forward looking companies are involved in in-depth studies to accommodate planned expansion in the electronic fields. In other words, they are interested in how changes may affect staff and staffing levels; and what requirements would be necessary to adapt the staff to it. For example, it is important to make a conversion to an automated system without making the office uncomfortable and untidy with wires, equipment and so forth. One has to ask: what is more important, the person operating the terminal or the terminal itself?

Another difficulty surrounds energy consumption. We all must use less energy, but it is also important to use less energy without making everyone uncomfortable. Unfortunately electronic equipment, particularly computer main frames, require extraordinary amounts of energy, if for nothing else than keeping cool. Air conditioning uses a great deal of electricity. Engineers must design systems that don't require too much air conditioning, but on the other hand, still provide the necessary cooling. Rooms that are too cool make operators uncomfortable. Uncomfortable people don't work at peak efficiency.

Because of the integration of so many factors -- equipment, HVAC, human requirements, etc. -- the fields of office architecture, mechanical and electrical engineering, industrial engineering and interior design are beginning to join forces. Of late many large corporations and institutions have developed their own in-house specialists to work along with outside specialists

and the staffs that will be affected. Consultants are relied upon to handle some of the constant cross referencing and state of the art problems. Difficulties arise, for example, when distributors of various systems do not incorporate good human factor principles into their equipment or layouts. Although the equipment may be first rate, unless it is utilized properly it cannot function as planned. To solve such problems as low morale, various techniques which depend upon the behavioral sciences, active participation of employees, training of employees and designing systems around the work experience of the employees are essential.

It is always essential to put people into focus, especially when introducing new systems. The environment -- or the way the office is designed -- has a lot to do with increasing productivity. If an environment is comfortable and the job is challenging and growing, the worker becomes productive.

As indicated there are strong suggestions that machines will take over many clerical functions in the years to come. By 1990 most secretaries will be involved in electronic mail transmission, data entry, data retrieval, data base updating, etc. Word Processing centers will handle most typing functions. People will need a higher level of training and will require better environments in which to work. This implies that many common industrial engineering methods will be applied to the office sector. Work flow and traffic patterns of people and information must be taken into consideration. Thus, although it is necessary for most corporations and institutions to define clearly what they want the new machinery to do, they must also

set interior design guidelines -- lighting, space, location, carpeting, acoustics, etc. -- for the vendors to follow.

Multifunction Computers and Minicomputers

In the 1980's the most significant technological revolution will be the advent of the multifunction computer, or the integration of the various technologies. New systems will blend four vital elements: data processing, voice and word processing and electronic messages. Electronic message systems, FAX switching, word processing and automated voice communications are being added to data processing exponentially today. (In the field of voice interactive computers, there is a distinct possibility that they will be commonplace 10 to 15 years from now.) There is a need for networks to unify systems back to the main data center, and at the same time, support some sort of decentralized processing. In other words, this demands an operationally consistent network.

Central to the whole phenomenon of totally integrated or multifunction computers is an approach that embodies several blessings: separate approaches to word and data processing now lead only to duplicated operational costs and redundant hardware costs; thus, merging the technologies will reduce both. It is important to remember that hardware has been the most costly item of the DP manager's budget (although some claim that over the long run the software outstrips this claim mightily). The reduction of hardware costs has resulted in an offering of ever increased computer power for the same number of dollars -- over the last decade. On the other hand, there is a definite

problem: since DP, Word Processing and other such managers have tended to have their own fiefdoms, will they be able to work harmoniously together when the systems are finally integrated?

So pronounced is this trend toward integrated systems that the evolution is going to alter the power of the purse within many companies. Many managers will see reductions in their own traditional decision making powers -- and will not like it. On the other hand, in the development of minicomputer networks, the equipment hardware and software developed initially to operate as stand-alone processing systems for data processing and remote program development, the current major application today are terminal-oriented, inquiry/response, data base applications. In the future, one will see more use of dedicated minicomputer networks operating in a distributed network independent of a central host processor. Here, specific managers will see their horizons expand. And this process -- if they are willing to retrain -- will allow them to give up priorities originally developed.

Small business systems and minicomputer networks will be increasingly important. There are several reasons why: first, hardware costs are already low and still declining -- about 30% per year. Secondly, software developments are making it constantly easier for non-experts to use on-line systems. This trend will accelerate.

Managing internal communications is also becoming a major point of interest. Ordinary phone service takes on the average of 3.8 tries to complete a one-to-one telephone connection with the called party. Reasons for failure include. "not there," "line busy" to misdialing. Intra-company communications is also less than efficient. It takes from 3 to 11 people to send and receive a message. Communications dovetailed into an overall multifunction system will be fact for many in the next years.

Then, too, mailing systems are growing in technological innovation, trying to match in performance other systems. The most significant event in 1979 was that the United States Postal Service approved the first electronic postage meter. The development of such meters and scales will provide many opprtunities in the future to increase the accountability of postage costs and services. (One of the most interesting is presorting incoming mail via optical codes to pick out those containing remittances so that monies can be more promptly put in the bank -- helping cash flow.) Satellite communication networks will also impact mightily on current postal service. Electronic mail and upgraded phone system which will include video are in the cards.

The point of all this is that the electronic revolution is going to cause a substantial change not only in the work force, but in work processes and the nature of the physical layouts as well. It is obvious there will be a substantial change in office environments. Over the last 2 decades offices have expanded at a considerable rate. Buildings that were built for a 20 year expansion, were filled in 2 years. The electronic systems

will change everything -- and if the futurists are right, allow people to be anywhere and still do the job. In other words, there is a strong possibility that many departments now centralized will decentralize and that certain job functions will be done in one's own home. Whether this will be true or not, no one can guess. But the office planner, overwhelmed with technological and flexiblity requirements, must keep his or her mind open and not bog down in traditional responses. The future appears to be less than traditional -- to say the least!

LIBRARIES
MEETING THE PROBLEMS
OF THE NEXT TWO DECADES

MEETING THE PROBLEMS OF THE NEXT 2 DECADES, A LIBRARY CHECKLIST

Since 1870 enrollments in higher education have grown at a compound annual rate of 5%, ahead of total population growth which was only 1.6%. Resources used by institutions of higher education have increased from 0.1% of the G.N.P. in 1870 to 2.1% presently (not including construction). This has had an impact upon all libraries. A better educated population tends to demand good library services.

However, over the next twenty years we are facing a number of crises in this country, not the least of which is that enrollments in the universities will fall even as the total population continues to rise. Then, too, energy difficulties, depletion of natural resources and monetary crises will cause rampant inflation. This dramatic situation has given rise to a great sense of uncertainty in the library field -- especially as the last 2 decades were a time of considerable growth. Therefore, to meet the problems of the next twenty years it will be imperative for academic and public libraries to:

.Analyze all factors likely to affect them:

- .Demography
- .Changing population mix
- .Labor-market changes
- .Institutions nearby
- .State population
- .Fiscal trends

.Insist upon Institution or system wide planning

.Avoid moving from crisis to crisis

.Anticipate future problems

.Encourage strong leadership of administration

.Recognize funding may be the root of the problem

.Give high priority to maintenance of quality

.Maintain high standards for staff

.Avoid excessive lay-offs or fear of lay-offs

.Make cuts by attrition

.Maintain high standards for the collection

.Enter new fields of technology to consolidate and to offer better services to the users

.Protect the collection budget

.Insist upon maintenance of the facilities

.Protect the life of the institution

.Encourage innovation and flexibility

.Establish funds for innovation

.Encourage new programs

.Encourage new areas of impact

.Encourage new administrative techniques

.Maintain at least the current level of per-capita funding in constant dollars

.Concentrate on proposals to federal and state governments and to associations that will result in better programs at no increase in real levels of funding

.Encourage flexible funding formulas

.Make internal funding flexible

.Encourage institutional consortia and intra-state/inter-state cooperation.

.Devise imaginative ways of approaching donors

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STEELCASE SURVEY

STEELCASE SURVEY

In April, 1978, Steelcase, Inc., -- the largest office furniture manufacturer in the United States -- commissioned the firm of Louis Harris and Associates to conduct a study of office workers and how they feel about their jobs, offices, office layouts, furniture and equipment. Questions centered on: whether offices contribute or detract from job satisfaction and productivity; the workers' perceptions of office tools, equipment, tasks and workspaces; and the workers' anticipation of changes on the job and in the workplace. The survey, which can be obtained directly from Steelcase and their dealers in its entirety, is excerpted below.

1. Office workers believe that better working conditions have improved the quality of working life over the past ten years.

   While 58% of office workers feel that the quality of life in general in the U.S. improved over the past ten years, 70% feel that way about the quality of their working life. 74% gave their companies positive ratings for better working conditions.

2. A majority of workers believe that satisfaction with office surroundings affects job performance. Doing jobs well, in turn, is central to both job satisfaction and getting the things most wanted out of life.

   A nearly unanimous 92% perceive a connection between personal satsifaction with their office surroundings

and their job performance. A substantial 74% felt they could do more work in a day than they do now, but 43% feel this could be true only if the conditions and circumstances they work in were changed. <u>The one measure most office workers feel would have a positive effect on productivity is a study and re-organization of work flow in the office</u>.

3. Helping and serving people is the most satisfying task for all workers; "taking instruction" is the least favorite.

   Managers and employees alike rate helping and serving people the best part of their job. It is also the one that demands the most time in general. However, secretaries and clerks spend most of their time "tending or operating machines" (including typewriters and calculators).

4. Most office workers believe that clear responsibilities, access to tools and interesting work are the most important criteria of a good job. To determine whether an office worker is satisfied with the job, one should look at what criteria is most important to them and contrast this with the attributes of their present positions. The most important aspects are (in descending rank order):

   . clarity of scope and responsibilities of the job,
   . access to tools, equipment and material needed to get the job done well,
   . interesting work

. feeling that a personal contribution is being made to the total work unit,

. friendly and helpful co-workers,

. challenging work,

. feeling like an individual -- not just a cog in a machine.

5. Most executives believe that increased productivity is the most important subject for the 1980's. But many workers do not believe they will benefit from increased productivity.

A substantial majority (73%) of office workers believe management would benefit a lot from increased productivity, as opposed to 44% who feel employees would benefit. In fact, many appear unconvinced that employees would receive major benefits at all. Furthermore, some office workers fear undue pressure on the job if productivity measures were introduced, and almost all workers -- with the exception of male managers -- are skeptical that they would benefit financially from personally increasing their productivity.

6. Office workers are mobile. Increasingly, they are changing locations, job functions and using more and more equipment with special wiring, noise abatement and spacial needs.

Constant change seems to be the order of the day. In the past 5 years, 73% of the workers surveyed experienced a change in the location of their workspace. 73% have had to learn new skills for the job. 72% have acquired new duties or responsibilities.

57% have changed jobs within their organizations. 54% have seen their offices redesigned or given new layouts. 54% use some type of data processing, telecommunications or electric equipment on the job.

7. Overall, office workers are satisfied with their office surroundings and their personal workspaces. However, for office workers who share offices with others, there is distinctly less satisfaction. For workers in private or "conventional" offices there is more.

   Office workers in "conventional" enclosed offices or cubicles are more satisfied with their surroundings than those in "open plan" spaces. They also tend to be older, and more likely to be on a managerial level. "Open plan" workers, who tend to be young (39% are less than 30 years old), are more positive about their workspaces than those in "bull pen" arrangements. In fact, the bull pen workers are consistently negative, calling their environments "uncomfortable," "boring," "just a place to work." This last group is fairly evenly split in age groups and work levels.

   Those in conventional offices are most likely to think their offices are "friendly," "comfortable," "suiting my personality," a "home away from home."

8. On the average, office workers spend 6 hours a day working in their own personal workspaces no matter what the job.

   Although most workers spend 6 hours a day in their own workspaces, they spend only about 4 hours a day at their desks. Managers spend the least amount of time at their desks, while secretaries spend the most amount of time.

9. Privacy related considerations seem to be most important, but provide the least satisfaction in offices today.

   Three aspects always receive low ratings in terms of how offices or personal workspaces function: "ability to concentrate without noise and other distractions," "conversational privacy," and "visual privacy." Visual privacy, although important, seems to be slightly less important for office workers except for Managers and professionals. Managers and professionals rate conversational privacy for their own workspaces very important. All groups rate the ability to concentrate without noise and other distractions as the single most important characteristic of an office.

   When asked what two or three aspects of their own personal workspaces they would change, most often mentioned was "more privacy" and "more space." More women are interested in the back support of their chair than men. Secretaries place more importance on chair comfort, task lighting, access to other areas and departments, access to tools, equipment and materials, and good heating, ventilation and air conditioning (HVAC).

10. Some aspects of office functions consistently turn up as positive. They are (in decending rank order):

    . Access to other areas and departments,

    . Storage space for working materials,

    . Safety,

    . Task lighting,

    . Back support and comfort of chair,

    . Working surfaces.

11. Heat, ventilation and air conditioning (HVAC) consistently turn up as a problem area. One out of four workers state that good HVAC is essential. This cuts across all employee levels and types of office arrangements. In fact 62% of the business executives felt this was the single most important functional characteristic of an office. "Being able to concentrate without noise or distractions" ranked second for business executives, with 50% choosing that as a functional characteristic.

12. An even 50% of the office workers single out a "neat and well organized look" as one of the 2 or 3 characteristics that seem important to them when they think about their own offices.

    The next most frequently mentioned quality of an office is: the amount of privacy, the overall amount of personal space, and the way it reflects the personality of the person working there.

The last issue is underrated by business executives as an important characteristic.

13. Status in the office is noticed. When asked what connotes executive level offices, the largest percentages perceive (in decending rank order):

    style of desks, tables and chairs,

    amount of privacy,

    overall amount of personal space.

14. The two words the majority of people choose to describe the offices in which they work are "functional" and "friendly."

    Male office workers, executives/managers/supervisors and professionals are more likely to describe their offices as "functional" while female workers, secretaries/clerks are more likely to describe their offices as "friendly."

15. Both the business executives and the designers agree that the "expansion of the office work force" is the most important reason behind most managerial decisions to update facilities. Other reasons are (in decending order):

    . reorganization within the company,

    . desire to increase work output,

    . need for better communication,

    . change in type of spatial needs due to increased reliance on electronic equipment,

    . need for more flexible office layouts,

. rising construction costs,

. desire for more pleasant surroundings for employees.

16. All groups (executives, workers and designers) agree there is a connection between employees' satisfaction with their office environments and their job performance.

The highest percentage of all three groups agree that "the study and reorganization of the work so that it flows more smoothly" is the measure most likely to have a positive effect on productivity. However, while a slim majority of executives and designers feel it is important to redesign the office space so that people will be less isolated from one another, a minority (only 29%) of the office workers feel that way. 54% of the office workers feel bonuses for no late or sick days would be effective, but only 35% of the executives felt that way. Compared to executives, office workers put a relatively higher priority on profit sharing as an impetus to their personal productivity. Executives are more likely to perceive investing in additional electronic data processing equipment as an effective method to raise productivity than the workers.

17. Many office workers feel that giving employees a greater say in office planning would increase their satisfaction with their surroundings and their productivity. This meets with less than an enthusiastic response among decision makers.

A 72% majority of office workers feel that having a lot to say in the planning of office space and the selection of the office equipment they use would have a beneficial effect on their surroundings. A significant number state it would make their offices more comfortable and efficient and they would feel more involved and become more productive.

A majority of these same workers anticipate managements' opposition to their participation in office decision-making. But over 70% said they would fight management opposition for a more pleasant and safer environment with better office furniture and better tools and equipment. Most workers feel it is important for them to have a say in "recommending office furniture," "arranging office furniture" and "recommending tools and equipment."

A less than enthusiastic 24% of corporate office decision-makers feel that a joint committee of employees, supervisors and senior executives should be included in office planning, while only 27% feel

employees should have any say at all. (37% of the organizations give their employees an opportunity to voice their opinions.) More acceptable to executives is the traditional use of supervisors and departmental heads as a means of obtaining employee input.

Surprisingly, the designers who were surveyed were more enthusiastic about dealing with workers' wants than executives. 41% believe a representative committee is an appropriate decision-making group.

18. Relatively few office workers are aware of the architects' or interior designers' role in planning the office spaces in their organization. Many design professionals feel there is inadequate communication with the eventual users of the spaces they design.

60% of the organizations interviewed retain outside professional help in one way or another in some of their in-house projects. 65% employ in-house design staff. Despite the widespread influence of designers, less than a third of the office workers are aware that outside design professionals have any role at all, and only a third are aware that even in-house designers may be involved. The reasons given for this are "employees are not asked," "they are not allowed to give their ideas," and "they don't want to make waves."

19. In preparing for office growth and increased productivity, decision makers believe the most important criteria to be considered are:

- suitability for electronic, telecommunications, and data processing needs,
- overall functioning,
- employee productivity,
- energy efficiency, and
- adaptability to changes in the work force.

At present, 94% of the companies interviewed are already investing in more electronic equipment and all companies said they plan to do so in the next ten years. New equipment often brings about changes in working relationships. 72% of the surveyed companies who have not yet rearranged offices feel they will do so over the next ten years, and 90% of the companies are currently studying ways to provide better interpersonal and interdepartmental working relationships.

20. Business executives, architects and designers agree that "employee productivity" and "energy-conscious design in new offices" will be a much more important issue in office design in the next ten years than it is today. Business executives also believe the following characteristics will become more important (in descending rank order):

- effect of office lighting on employee vision,

. safety in the office environment,

. increased attention to the design of the work flow.

The major reasons for the increased popularity of the open plan layout among decision makers and designers are seen as:

"ability to change layout with minimum cost,"

"ability to change layouts with minimum dislocation."

There are only two major or serious drawbacks to open plan design:

"loss of visual privacy" and

"suitability for certain types of buildings."

The Lou Harris people are disturbed by the inferences of the study. They conclude that a collision course between management and employees is indicated -- however, they do not speculate on the depth of this collision. They believe the degree of employee involvement in decision making might become another "hot issue" rather than a tool for solving communication problems. The stake is productivity in the workplace. Difficulties to be overcome are:

a. too little consultation with workers affected by change,

b. too much avoidance of the privacy issue by those in charge,

c. too little understanding by office workers for

reasons behind decisions,

d. too little dialogue between office workers, managers and designers.

WORK IMPROVEMENT / WORK SIMPLIFICATION

WORK IMPROVEMENT

Over three hundred fifty work analysis, work-improvement or time-study titles are added to the Library of Congress each year. These books concentrate on analyzing work flow. Their purpose is to help reduce costs and improve productivity in the working environment.

Back in the 1920's and 30's, the majority of time study projects took place in factories. Since the 50's, these studies have shifted from manufacturing and production to white collar sectors. This is especially true lately. One of the reasons for this has to do with the enormous growth of the white collar sector. Governmental agencies and corporations that once ignored unproductive bureaucracies can no longer do so. Too many white collar workers exist; inflation and declining productivity are causing strains on operating expenses -- and in the case of corporations, squeezing profits.

The application of automated systems to the work environment has a direct relationship to such time-study projects. For some, automation is looked upon as a salvation, a way to cut operating expenses and a means of eliminating duplication of effort.

By automated systems we mean any system using machinery in the work process. In the white collar sector, such machinery may include:

- copiers
- calculators
- postage meters
- compact shelving
- microfiche, microfilm machines

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. dictaphones

. computers.

In other words, although computers are immediately brought to mind when one speaks of automated systems, computers are just one aspect of the field -- and, we must admit, the most exciting aspect.

As one can see, the machinery involved in automation comes in a wide variety of types and applications. Some require extensive space, while others only some small place on a desk top. Certain pieces of equipment cannot be purchased without thinking the implications through, either because of the expense involved or the dislocation of space, while others can be bought without any thought at all.

Furthermore, each new innovation in office equipment introduces another white collar group. And each white collar group appears to have its own methods, jargon and claims of improved productivity. The problem, then, is the plethora of so many different kinds of machinery, with so many different applications and apparently so many different and unrelated reasons for existence. Offices become gadget bound, and the automated systems don't automate anything at all. The different requirements and ways of working are actually counter productive.

However, if we carefully examine the various white collar fields, we will see that work procedures from one field to another are not as unrelated as they first appear -- and in the long run, many procedures can be integrated so that they work together and work productively.

Many white collar processes tend to be repetitive. Automated systems are especially applicable where processes are repetitive. Computerization, for example, first made inroads in the office in the fields of data processing (numbers), such as bookkeeping and accounting. There repetition is obvious. Currently inroads are being made in word processing (typing) and information retrieval (filing). Electronic mail and managerial systems have already appeared on the horizon. Within a few years, they will be as common as word processing systems.

The repetitive nature of many common work functions is conducive to reorganization. Tasks which depend upon these functions are simplified and the time it takes to perform them are minimized. For example, one major corporation found that every document within the organization was copied, on the average, 18 times and that 8 of those copies ended in someone's files. Electronic filing can eliminate multiple copies -- and if the process is carefully considered, retrieval by cross referencing or retrieval by simple key words will be easier when using a desk top terminal. Here, of course, the program for input and output is of ultimate importance. It depends for the most part, upon a careful analysis of the work to be done.

The primary method to improve white collar productivity coincides with some of the same methods of work analysis. These methods must be

. detailed enough and

. simple to use.

Then, too, one must always remember that work improvement centers on people. If automated systems simplify work flow, then the people that guide those systems are of primary importance when considering any changes that take place.

A new breed of worker is now in the work force. This new breed has had to deal with the mind boggling technology, the social upheavals and the changes in the family life which occurred in the 1960's and 1970's. This new breed has spent more years in school, travelled more widely and become more aware of citizen rights than its predecessors. Quite frankly, many of them don't want to be "pushed around.' They expect and demand:

- to be recognized as individuals and treated like adults,
- the right to know, an equal opportunity, and a voice in decision making processes,
- a chance to lead whole lives, continue education and self development, and an opportunity to use their mind,
- a world of options, instant gratification, and challenge.

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What we are saying, then, is that the application of automated systems to any organization will fail unless the work force sees itself involved and directly benefitting. Of course, direct benefits can be perceived in a number of ways: better jobs, better working conditions, or more money, to name a few. But, unless a majority of the employees believe that the changes are sensible, they will pay only lip service to those changes and in their daily work will con-

tinue to do what they always did. Why should they revise ingrained habits?

Then too, employees may embrace the changes in the work process, but disagree with the direction that management takes. Usually management applies an automated system to an office because such systems are viewed as cost effective or productive. The employees, on the other hand, may want to derive more social or psychological benefits from their work activities. Taking 3 clerical desks and ganging them together may be viewed as systemizing a particular work function to get it done faster. The 3 clerks may see that same change as an opportunity to talk and work at the same time. This apparent dichotomy needs to be recognized.

Regarding the effects of automation on motivation, a 1976 FORTUNE MAGAZINE survey showed: four out of five managers agreed that greater employee motivation could improve productivity just as much as more advanced equipment. Furthermore, two thirds of the executives agreed with the statement that the manufacturers of office machines are advancing their technology faster than business and government can take advantage of it. This is still true today, even though the cost of the most expensive automated systems has come down drastically in the last several years. As business and government agencies get bigger and bigger, employees tend to get more and more alienated from their jobs. Motivation falls. So does productivity.

But, we are entering an age of uncertainty. The rapidly increasing costs of energy may change the economic system drastically. Cer-

tainly, over the next decade it will cause some economic dislocation. Fear of losing one's job and an inability to replace that job with another one, may change workers' views of their jobs. Motivation to keep their jobs and productivity may rise in spite of the alienation they may be feeling. We shall see what we shall see.

But in the mean time, as far as applying automated systems in large scale to an office, we can only rely on past experience. And past experience tell us that unsuccessful attempts to automate have been characterized by:

- sudden management moves without warning to employees,
- quick reduction in work force so that employees that are retained become anxious about their jobs,
- little involvement in planning changes by those most affected,
- poorly selected equipment, poorly designed equipment,
- poorly placed equipment, poorly arranged workstations or offices,
- work flows which limit individual work scope and opportunity to advance,
- poor definition of which is more important: work decision or system decision,
- inadequate training

Successful office automation includes:

- involving workers with planners,
- reduction in work force by reassignment, retraining and attrition,
- consideration of employees when thinking about purchasing equipment,
- improved work flows, clearly delineating decision-making paths,
- improved office or workstation design, layout of equipment in space,
- proper employee training, less reliance on on-the-job learning,
- management style which attempts to motivate and not threaten.

Once the decision has been made to automate, we must keep in mind those elements which assure success. Now, let us examine the appropriate goals and the necessary steps.

WORK SIMPLIFICATION

A primary goal is work simplification, or an organized study to improve work methods. It has always been part of the managers' or supervisors' responsibilities to improve jobs and methods, but now results can be greatly improved by using the new technologies. Work simplification can also be attained by eliminating duplication.

The study of work simplification is beneficial to all concerned. Employees benefit because work is made easier; it's less fatiguing and it's more productive. There's less duplication. Management

benefits because work is more productive, less costly and more profitable; operating expenses are reduced and automated systems are utilized. The client appreciates the better services received.

In order to be successful in improving methods, the best approach is to observe present and future operations with a questioning mind. When observing project operations, nothing is taken for granted, everything is challenged. One should have few deep-seated convictions; accept little or nothing as being correct simply because it exists. Instead, ask questions; otherwise there will be no answers. Always question procedures and operations as to their practicality. Always ask questions even when the answer appears obvious -- one may elicit some new and beneficial contributions.

It must be clearly understood that the asking of questions is not a mark of ignorance. As a matter of fact, one is much more likely to find that the people who ask questions are at the head of an organization and, those further down the line do not. Asking questions enables you to obtain information from others, and to win cooperation.

PROBLEM SOLVING PROCESS

A. Define Problems
B. Collect Data
C. Develop Possible Solutions
D. Evaluate Alternatives/Advantages/Disadvantages
E. Recommend Criteria To Be Considered
F. Recommend Actions To Be Taken

A. Define Problems

Work simplification, task reduction, elimination of duplication and automation may be readily available in certain areas, but one must first determine just what the problem is, and that's not such an easy task. Sometimes the following statements are made: "costs are too high," "output must be increased," or "there's a bottleneck in the processing of...." The actual problem must be sorted out and stated. It is essential to know the specific reason for working on the job, the limits of the type of solution and the tentative means by which the solution can be found. It is equally essential to arrive at the root, or cause, of the problem, and to avoid stopgap solutions which merely cover up symptoms.

B. Collect Data

Getting all the information about procedures, paper flow, equipment and sequence of operations is necessary before a final solution can be made. If there is a secret to work simplification it is a straight forward matter of gathering, sorting and factoring out common work processes. This reduces duplication of effort and clarifies work tasks.

In some cases it has been found that work simplification, task reduction and even automation does not necessarily reduce operating expenses on a short term basis. In the long term, savings may occur due to increased service programs and greater turn around time ... efficiency and productivity.

With automated systems, the line is held if and when services increase. Up-front costs of automation and miniaturization tend to be very expensive, so careful budgeting is essential.

C. Develop Possible Solutions

After gathering information, we are in a position to determine some of the ways in which the improvements can be made and the problems solved. Lists should be made of various ways to improve the job, and the possible solutions and also the advantages and disadvantages.

D. Evaluate Alternatives

When evaluating possible solutions, the following steps should be taken:

- assess priorities,
- review data collected,
- review existing organization, their structures, policies and procedures
- explore areas of possible consolidation,
- review automation of systems and miniaturization,
- propose methods to increase service to "clientele."

The proposed method of improvement must be analyzed to determine the cost of implementing the idea -- the savings or benefits that can be achieved. The methods should increase productivity and effectiveness in completing work tasks.

Automation Alternatives

When evaluating automated systems, the following points should be considered:

- implementation costs,
- service to "clientele" users,
- service needs,
- reduction in operating costs,
- increase staff productivity (work flow, work simplification),
- improved operations
- elimination of duplication of effort.

E. Recommend Criteria To Be Considered

Organizational charts, graphs, surveys, matrixes and other analytical instruments should be used. Data should be analyzed systematically. Conclusions must be drawn. From those conclusions, recommendations for project implementation should be made.

All recommendations:

- Must be realistic and obtainable and lead to general courses of action.
- Must have reasonable time frames in which to implement.
- Must have methods of monitoring progress and up-dating.
- Must have a cost comparison for alternate solutions.
- Must have a cost analysis.
- Must satisfy "clientele" needs and/or desires.

Recommendations may include short-range and long-range plans.

Short-range plans may be implemented immediately and require little or no funding or training of staff. Long-range plans take a number of years to implement.

F. Recommend Actions To Be Taken

It is essential to communicate the recommended action to the people who will implement it. Almost all personnel complain that their ideas are either not solicited or are disregarded.

The major methods of communication are oral, visual and written reporting. The presentation of an idea can often be the determining factor as to whether or not it is accepted. For example, without a detailed cost analysis it is not possible to intelligently evaluate a recommendation.

In most business operations, there is no final solution to a problem. Henry Ford said that if something is made for the same way for six months, we should check the method; and if it is made the same way for two years ... then there must be a better way. A procedure or solution should be put into effect and used only until a better one can be found. It will be simplier to uncover new solutions if one opens the lines of communication to all interested parties. The acknowledged credit for new ideas is a method of encouragement and acceptance.

The implementation of recommendations should consider and take into account the following:

. Monitoring implementation.

. Setting up demonstration models to test and measure.

. Training staff members.

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TIME STUDY

PAGE | OBSERVER | PART NO | OPERATOR NO

DEPT. | EMPLOYEE | OPERATION | PART NAME

DATE | START | STOP | EQUIPMENT | MATERIAL

LIST OF ELEMENTS PERFORMED			OBSERVED TIME -										TOTAL		AVERAGE		OCCURRENCE		ADJUSTED TIME STUDY	
NO	USE	DESCRIPTION OF OPERATION	1	2	3	4	5	6	7	8	9	10	TIME	NO	TIME	RATE	TIME	FACTOR	TIME	PER

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SHARED EQUIPMENT INVENTORY

GROUP	EQUIPMENT	INDIVIDUALS	REMARKS

THE BEHAVIORAL ASPECTS OF SPACE

THE BEHAVIORAL ASPECTS OF SPACE

It seems we have a personal space around us, a space somewhat larger than our body. It is hourglass shaped, fairly large in the front, narrowing at the sides, and swinging out in width behind our backs. Robert Sommer, author of PERSONAL SPACE, THE BEHAVIORAL BASIS OF DESIGN (Prentice Hall, 1969) describes these space:

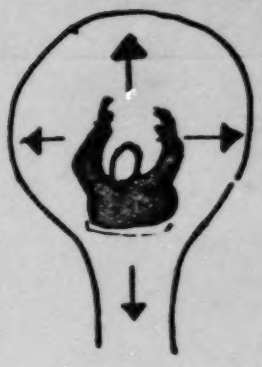
The intimate space are those areas less than 18" away from our bodies. Anyone standing or sitting less than 18" away is in close proximity indeed. Lovers, mothers, fathers, extremely good friends may get that close. Other people entering the intimate space we consider to be bad mannered, and perhaps even hostile.

Personal space is the space in which we allow good friends to enter. It is between 1-1/2' to 4'0" away from our bodies. Americans carry on animated conversations standing that far apart.

Social space is the space in which many business and interpersonanel conversations take place. People stand 7'0" to 12'0" away from one another. (For example, a worker will call over to another worker seated as far as 12' away rather than getting up. Beyond 12' the worker will usually rise and walk over to the other worker to engage in conversation.)

Public space is that which is 12'0" to 30'0" away from our bodies. Here people may enter and therefore enter our consciousness, but they do not interact with us. Beyond 30' we are not even aware of people as people; they are part of the scenery.

PERSONAL SPACE



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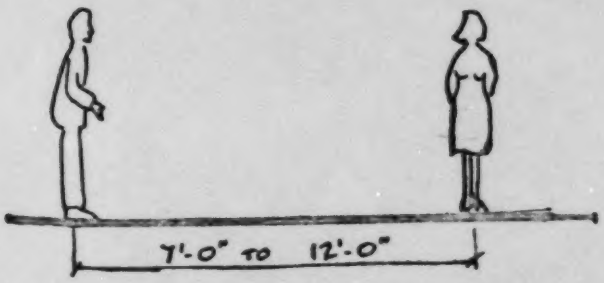
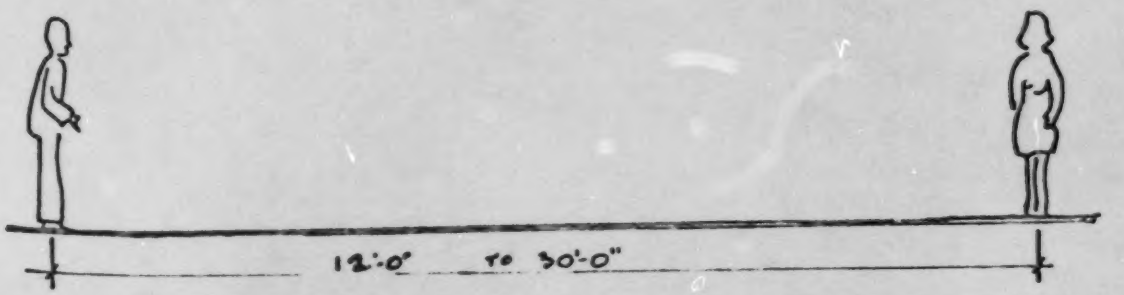
Intimate Space:
18" away (lovers)

Personal Space:
18" - 48" (close friends)



Social Space:
7'0" - 12'0"
(Business conversations).



Public Distance:
12'0" - 30'0"
(recognition)

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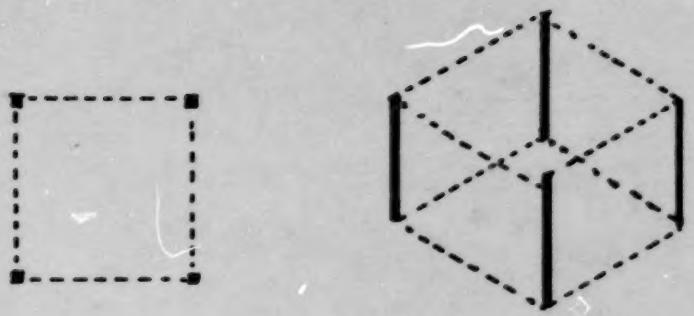
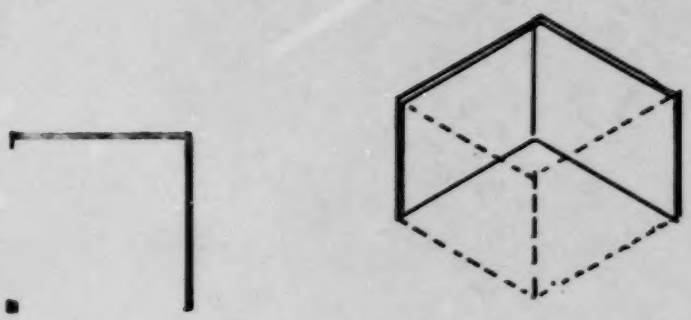
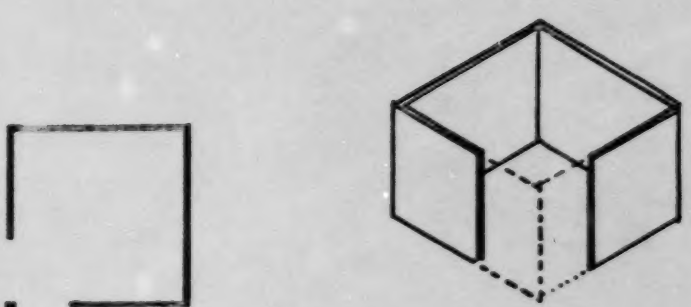






Open Environment

"colonade" ... appears to have more room for bodily action :

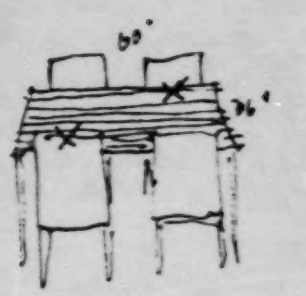
. there is a psychological feeling of flexibility created by indefinite physical confinement

. as the solidity of the mass is increased, it appears that the flexibility of use is decreased

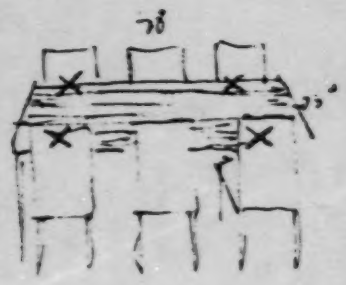
. a fragmented shape appears to have a potential to grow.... this potential is one of the "positive" aspects of the "open landscape"

Confined Environment

Closed in every direction
. limited in ways it can grow.
For certain people a "closed" environment affords security, a feeling of territorality, an appearance of privacy.... this is one of the "positive" aspects of the traditional office.



GOOD -
BEHAVIORAL - USER PREFER
SMALLER INDIVIDUAL TABLES
USER STUDIES INDICATE ....
ON PRIVACY



POOR

VERY BAD FROM PRIVACY
POINT OF VIEW

BAD

ROUND TABLES GIVE NO SENSE
OF TERRITORY - NO DEFINITION
OF BEHAVIORAL QUEEN OVER SAND

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It must be noted here, that these so called "personal spaces" are by-products of our cultural heritage. Although it is fashionable to deny that there is an American melting pot, sociologists have found that there is a decidedly American cultural norm that cuts across all ethnic and/or racial differences. For example, Europeans living in the Mediterrean area stand much closer to each other when conversing than Americans would dare. To stand in such close proximity is quite disturbing to us; Americans neither like to smell the breath or feel the bodily heat of acquaintences. Indeed, for us, such proximities would have sexual overtones.

Arabs also have extremely different attitudes towards the territories that surround their bodies. Arabs do not consider the personal spaces of perfect strangers to be of any importance at all. The people living in the western societies (in Europe and the United States), on the other hand, are at times even more careful about the personal spaces of strangers than those of friends.

However, in the United States, there is an amorphous underclass whose composition varies from time to time according to social pressures. This underclass is not necessarily either ethnic or racial in its makeup, but does exist on the lowest levels of American society. It appears that many of these people have different interpretations of personal space than the citizens of the rest of the nation. The members of this underclass do not recognize the personal spaces of strangers, although they appear to be very defensive about their own. Their bodily stances often are interpreted as hostile by the rest of America -- even when no hostility actually is being projected.

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O.K., the question then, is what does all this have to do with space planning and the practical design of offices? Well obviously, setting up an office facility determines how close people must work together. If people are placed too close overcrowding may result, and overcrowding may lead to poor morale. (Let's face it, in the end, poor morale is the result of poor management; working conditions are only one aspects of this situation).

First, let us examine the reception area. Here because the office wishes to put its best face forward and impress potential customers, the most design dollars are spent per square foot (in relation to the rest of the facility).

Large couches often are found in reception areas, and they are chosen for large couches as big objects are considered more impersonal in nature than smaller couches or chairs....and office designers want the reception area to appear serious (and perhaps professional) in nature. Secondly, large couches are considered more masculine than cozy chairs and no matter how we deny it, the work-a-day world is still a man's world. Finally, most office designers just simply seem to like large couches...they're "cleaner" to work with.

If there are three couches and three strangers in the reception area, each one will choose to sit on a different couch...providing of course, that all things remain equal: each couch is in the same repair, has the same lighting, is in the same proximity to the reception desk, and so on and so forth. If there are two couches, and three strangers, one couch will seat two people -- at opposite extremes of the couch -- and the third stranger will sit on

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the other couch. If there is only one couch, two possibilities may result: either two people will continue to sit, and one will remain standing, finding a variety of things to occupy himself: finding the men's room, rummaging through his briefcase, making telephone calls -- or the third man may squeeze between the other two on the couch. In this possibility, conversation may occur between the strangers because of their close proximity. But any way one looks at it, the three strangers will be uncomfortable.

It is very difficult, you see, for an American to seat himself in such close proximity to people unknown. That's why during the rush hour in New York City so few pick-ups are ever made on the subway. The closeness of complete strangers, bodies touching bodies, is potentially hostile, decidedly unfriendly.

Ofcourse, all such information must be taken with a grain of salt. Occasions do change, and when active socialization is expected to occur, many of us decrease our personal spaces significantly. In a singles bar, for example, people sit willing in close proximity to perfect strangers with the likelihood that the perfect stranger on the next stool may become a close acquaintence very suddenly. At a party we let down our guard an even put an arm around people deemed adversaries "out on the street."

Then too, people, either because of different cultural upbringings or because of years of training do have smaller personal spaces surrounding their bodies than the rest of American society. We all know the cliche of the salesman-bore who sidles up to a stranger and becomes much too friendly

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much too quickly. But since many salesmen sell their personalities as well as their products, a decreased personal space may be part of the game.

In regular office areas, then, one would be foolish to place co-workers to close to one another. Overcrowding makes work difficult to proceed. Therefore each and every worker must have some territory, no matter how little. to call his/her own.

Here, then, we go into another area, that of territorial definition. People, it seems, like to mark out their own territories, even in areas considered public. For example, in a library one will find patrons not only sitting as far away from one another as they can, but they will place their belongings in such a manner that it is rather difficult for anyone to sit either opposite or adjacent to them.

In addition, most of us like to sit so that our backs and sides are protected. For example, studies have shown that in a library in the main reading room, the rear tables become occupied first, then the tables around the periphery, and finally the center tables. The most favored positions seem to be those farthest away from the entrance, with one's back to the wall. . .in a position of active defense.

We do this in our offices too. Those with private offices will generally position their desks so that the desk acts as a barrier between the door and the "managerial chair". How interesting that so many people fight for

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the office with a window, and then proceed to place the window to their back, so that their desk is between their body and the door. (They only get the view those odd moments when they walk in and out of the room).

This, then, also in part explains the sudden rush toward modular furnishings which are all the rage today. By utilizing such furnishings along with their easily moveable partitions, even the lowliest worker can have a feeling of protection and territory. In older offices, lowly clerks sit in a "bull pen" arrangement, row upon row of desks. Someone is always looking at them, "breathing down their necks." Only managers are given offices, and offices around the periphery of the building.

It is interesting to note that when managers -- who have a higher status level (in their own eyes) than clerks -- are forced to use modular furnishings, they carefully position workers in such a way that no one can come into the manager's presence without walking past the buffer of other personnel.

The modular furniture is good for the worker on another level. It seems that Americans do not like to look into the eyes of people with whom they are not engaging in active conversation. In other words, a worker looking up from his/her desk always does not want to see the eyes of the co-worker seated across the way. Many people do not seem to mind looking up and noticing office bustle (in fact many people seem to thrive on it), but do mind looking up and seeing another person staring at them. By the use of the modular partitions, a worker may look up, have a sense of office life, but still get a feeling of protection.

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However, as with everything else, modular office furnishings have drawbacks. First, if given the choice between modular furnishings and partitions or a standard, old fashioned office, most workers will choose the office....their territories are better delineated in a standard office. Secondly, modular furnishings often are placed helter skelter in a facility without feeling of form or definition. In some of the larger complexes, workers get the definite impression that they are only rats working in a maze....too many partitions and few clear cut corridors. For that reason we believe especially in larger facilities, floor to ceiling walls should be placed whether they are needed or not, just to give that definition. In addition, offices utilizing such furnishings should be set up around a core so that one can sense who one is and exactly where one works.

Which leads us to another point...the differences between sociofugal and sociopetal spaces. Sociofugal arrangements are those which tend to keep people apart. In some offices, for example, those little offices leading out into long blank corridors prevent worker to worker interaction. Of course, for certain companies this is deemed beneficial. Editors, advertising copywriters -- the "creative" people may want a quiet space, away from the rest of the facility so as to concentrate.

A sociopetal space arrangement, on the other hand, encourages interaction. Here the best example is that same clerical department which not only places one clerk adjacent to another in a "bull pen" arrangement, but backs one desk upon the other. Two people sitting face to face, no more than 6 feet apart, will talk if for no other reason that whenever one looks up he/she sees the other's face and eyes.

Another example of a sociopetal arrangement is that in which all small offices are ringed around a circular inner space. The smaller that inner space, the closer the doors each individual office will be. The closer those doors -- and the

fact they are invariably left open ..(Americans do not like office doors to be kept closed, we find something sinister about closed doors), the more likelihood office worker interaction will occur. Each time anyone passes through the inner space, eye contact will probably be made with one of the occupants of the individual office. Eyes meeting even for an instant requires conversation -- if no more than a greet

Finally, a word about private offices: here in the U.S. there is great mobility between classes, a mobility we are proud of, and in fact, some of us would deny there are any classes at all, that we are the one great classless society. However, in office facilities the social hierachy is rigidly enforced. In this land of opportunity as one moves up the corporate ladder, one receives the key to the executive washroom, or an invitation to dine in the executive dining room, and certainly a bigger and better office. Sometimes the differences in better offices can be measured in inches! At a famous corporate headquaters in Greenwich, Ct. a facility which sports numerous design awards, not only do the executives receive ever bigger offices around the periphery of the building as they rise through the ranks of management, but once they reach the very top echelon they segregate themselves in an entirely separate building -- approachable only through a long tunnel.

The idea of giving the best offices along the periphery of the building to top management is not a fact of life throughout the world. For example, in France, a place famous for its radiating star pattern of space arrangements--(think of the Paris traffic pattern) to find the head of a department, one simply looks for the center of things.

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Having an office cut off from the rest of the facility, then, is not always a good thing. At a major U.S. corporation located in a western state, the President of the company found himself too far away from the office bustle in his corner office with a commanding view of the countryside. He felt that he was losing touch, so as reported in several magazines, he gave up his magnificent office and moved into a smaller one more centrally located.

Some of us, of course, do have a desire to keep apart. Many of us spend time designing our offices so that the long walk across the room to the great barrier of a large desk is unsettling to underlings. Then there are those tales of the movie mogul who built a six inch platform on which he rested his desk and chair. A short man, he found his elevated desk made him seem commanding to those standing before him.

How one places one's desk, and how one is approached by co-workers sets the rules of the game. For example, when working with another person it is very difficult to mark out territory on a round table. The very roundness prevents class distinctions; no one is seated at the head -- each one is equal. Round tables, then are better for conversation. Rectangular tables for work. Large tables, more than 5' wide tend to inhibit friendly conversation. That's why we take out so many potential customers to lunch. Resturant tables are very narrow, and although the table still represents a barrier, we are able to sit closer to a business associate than normal office interaction would allow. (By sitting right next to a business associate or co-worker, unless working on material that must be shared, we are infringing upon the personal space. A potentially sexual and/or hostile situation is then set up).

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To inhibit friendly conversation and limit the time of mini-conferences, the visitor's chair in the managerial office has to be chosen with care. A rather uncomfortable chair positioned in front of the desk, rather than to the side of it, is one suggestion. Some executives frown on any visitor's chairs at all. Anyone entering the executive office must stand, state his/her case and leave. Not only does that give the seated executive the decided advantage in comfort, but implies that the visitor has a lower status.

And so it would seem how we design our individual offices, if not the entire corporate office, tells a great deal about personalities. In addition, a badly designed complex tells something about higher management's ability to keep morale steady. For businesses dealing with a 25% a year turnover, giving Lou and Suzie a nice place in which to work and a feeling of territory may be one aspects that aids them to identify with the company -- and the corporate goals.

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ORAL 1. [illegible] 4. _____
IVES 2. [illegible] 5. _____
3. [illegible] 6. _____

WHEN USED: Day 70 % Night 30 %

LIGHTING BUDGET TYPE: C

PROJECT

INFORMATION NEEDS

k INFORMATION NEEDS

- Routes, signs, layouts of objects and building elements
- Levels, edges, obstacles, people, and other moving objects
- Shape of space, relation to exterior
- Nature of enclosing structure
- Daylight reference
- View of sky, winds, rain, sunlight, artwork, and other people
- Isolation when desired
- No disturbing color
- Expected relationship of brightness: interior surfaces to exterior

HARDWARE SYSTEM

O CHARACTERISTICS OF VISUAL ENVIRONMENT

- Positive, clear articulation of paths, nodes and areas by building elements and graphics
- Adequate illumination, shadows, gradients: minimum disability glare, irrelevant disturbing pattern
- Spatial and structural articulation
- Clear windows, skylights
- No glaring light fixtures; relevant order of focus for activity and characteristics of space
- No mixed color sources on similar surfaces in similar circumstances
- Illuminated wall and ceiling surfaces during the day to balance window brightness and to relate to exterior daytime conditions

U NUMERICAL CRITERIA

Unit of Measure	Req. Value

FOOTNOTES

i LOCATION HOR. Local	i LOCATION HOR. General	i LOCATION VERT. Local	i LOCATION VERT. General	j REMARKS
				GARDEN SPACE

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SPACE PROGRAM CHART

SPACE TYPICAL DINING HALL

BEHAVIORAL OBJECTIVES
1. PLEASURABLE FRIENDLY ATMOSPHERE
2. ENJOYMENT OF FOOD
3. GOOD RESOURCE UTILIZATION
4.
5.
6.

BIOLOGICAL AND ACTIVITY NEEDS

a BIOLOGICAL NEEDS

Movement
Relaxation – Stimulation

d PRIORITY %

10
20

e VISUAL SUB-ACTIVITIES

Circulation information
Physical Dangers
Orientation in space
enclosure
time
weather
Restful visual activity of interest
non-activity
No distraction by high signal noise ratio
upsetting constancies
upsetting expectations

b ACTIVITY NEEDS AND SUB ACTIVITIES	c PARTICIPANTS: DINERS	STAFF	AUDIENCE	MAINTENANCE	d PRIORITY %	f VISUAL OBJECTIVES: Looking at	g EVENTS: A DINING	B DANCE	C LECTURE	D AUDIO-VISUAL	E THEATRE	F CLEANING	h PRIORITY %	j LOCATION: HOR. Local	HOR. General	VERT. Local	VERT. General	j REMARKS
EATING, DRINKING					20	FOOD							40					
						DISHES, UTENSILS							5					
						TABLE & FURNISHINGS							5					
CONVERSATION					15	FACES, GESTURES, CLOTHING							15					
READING, BROWSING					5	MAGAZINES, BOOKS, NOTES							5					
SOCIAL DANCING					5	SURROUNDINGS							5					DARKEN SPACE
LECTURE					5	FACES, GESTURES, CLOTHING							3					
LECTURE, AUDIO-VISUAL					5	PROJECTION							2					
VIEWING PERFORMANCE					5	PEOPLE							4					
						PROPS							1					
SERVING					5	UTENSILS, FOOD							4					
						FLOOR							1					
CLEANING					5													

INFORMATION NEEDS

k INFORMATION NEEDS

Routes, signs, layouts of objects and building elements
Levels, edges, obstacles, people, and other moving objects
Shape of space, relation to exterior
Nature of enclosing structure
Daylight reference
View of sky, winds, rain, sunlight, artwork, and other people
Isolation when desired
No disturbing color
Expected relationship of brightness interior surfaces to exterior

l OBJECT CHAR. 2D	l OBJECT CHAR. 3D	m INFORM. NEEDS: Reflectance	Form	Texture	Color: Non-disturb'g	Color: Accuracy	Transparency	Other	n NEG. FACTORS: Context	Cast Shadows
	2.9									
	1.11.13									
	1.2.9.14									
	2.9									
2.5										
	2.9								*	
	2.9									
.2									*	
	.12									
	1.7.9 5.9									
	1.2.9 11.13									
	.10									

LIBRARY MANAGER'S ROLE / PRESENTATION TO MANAGEMENT

LIBRARY MANAGER'S ROLE

A. Identify Need(s)

B. Decision Is Made To Correct Problems

C. Organize Teams

    1. Enlist Support And Experience Of Staff

D. Set Schedules

E. Analyze Needs

    1. Areas Of Impact

    2. Automated Systes Vs. Integrated Systems

    3. Tabulated Numbers

        a. Shelving, Cartridges, Machines, Future Expansion

    4. Costs

        a. Buy, Rent Or Lease

        b. Future Costs Ex. 5 Year Plan

F. Analyze Work Flow

    1. Break Job Into Parts

    2. What Needs To Be Where

G. Analyze Physical Areas

    1. What Have You Got

        a. Use Blueprints

        b. New Facilities

        c. Off-Site Storage

        d. Separate Facilities

H. Hire An Architect

I. Diagram New Areas

1. Use Blueprints, Graph Paper
2. "See" Work Flow
    a. Move One Function - What Effect?
    b. Comfort
    c. Noise
    d. Is Physical Layout Comfortable
3. Present To Staff For Comments

J. Presentation To Management

K. Changes Or Alterations

L. Alternative Plans

M. Committment Is Made

1. Orders Submitted
2. Records Management
3. Work Orders - Physical Changes To Area

N. Delivery Is Made

1. Verify
2. Records Management

O. Installation Of Equipment

P. Set Work In Motion

1. Get Kinks Out
2. Get Staff Opinions

Q. Promotion To Users, Management

1. Brochures
2. Tours
3. Publicity
    a. Company Newspaper

R. Draft Plans For New Facility

PRESENTATION TO MANAGEMENT

A. Identify Audience

B. Organize Team

C. Chart Program To Be Given

   1. Divide Time Into Slots

   2. Plan What Goes Into Slots

D. Assign Tasks

   1. Development Of Prototype

   2. Charts, Flow Diagrams

   3. Tables

   4. Advantages/Disadvantages

   5. Time Frame

   6. Cost Analysis

   7. Changes In Procedure

   8. Changes In Staffing

   9. Needs Assessment

E. Coordinate And Merge Information

F. Dress Rehersal

   1. Time The Program

   2. Ask Staff For Criticisms

G. Actual Presentation

H. Analysis Of Performance

IMPACT OF AUTOMATION

IMPACT OF AUTOMATION

While planning to automate, one must also be aware of the impact automation will have upon the working environment. To define and solve problems, outlining a course of action and monitoring its implementation is not all that should be considered to insure success. To be aware of the psychological and organizational impacts is very important -- to be forewarned is to be forearmed.

Changes occur in both the organizational structure and, subsequently, the attitudes of the employees. As systems are automated, job descriptions and responsibilities may change; people may assume different tasks and find they interact with a different set of employees. They have to learn new tasks, deal with new employees and feel comfortable. Because they don't know the new employees, they can't anticipate the responses they will receive or whether they will be liked and appreciated. They find themselves trying to learn new skills while feeling uncertain of the support. Any form of change is anxiety provoking, and in this situation they have a lot to adjust to. Tasks and colleagues are two major areas of work life and if they both change the environment seems very unstable and frightening.

The new tasks assigned often require new skills. Because their lives have been so disrupted, people usually approach the situation with some anxiety. Consequently, it is imperative that they receive proper instruction as well as an understanding of how their jobs change, why and what is expected of them. When

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a new machine is installed, an operator's manual and perhaps a minicourse of instruction is not sufficient in helping the employee learn and adjust to the new job. Since people are aware of the changes around them, they must be aware of how they fit in and the responsibilities involved. Sometimes people must adjust their way of thinking, their perception of the job and how to do it. For example, in the past a secretary was taught accuracy was more important than speed. With word processors, speed is of the essence. Everything is typed in draft form because the machine types the final copy. So now the goal is to get as much "into" the machine as one can, as fast as they can. If the secretary hangs on to the idea of typing accurately, her job may become more difficult and the purpose of the machine is defeated.

When the organizational structure changes, social relationships also change. Employees may be reassigned or find they will be working with a different group of people. People may dislike the fact that they no longer come in contact with their friends and then resent their new colleagues. They may begin to spend more time socializing since they no longer are in close proximity with former colleagues. At times the boss will be blamed for these changes and negative attitudes or morale problems may develop. The social aspects should be considered as a means of providing good working conditions.

As we saw before, automation was initially introduced in manufacturing plants to improve productivity and working conditions. New technologies were then developed for the office workers.

Studies now show that the factory workers' working conditions were improved but this question is still being examined regarding office workers. Manufacturers of automated equipment will be quick to tell you that the working conditions are greatly improved but this may not be the case. Aspects of the employees' situation may improve while simultaneously other problems may develop (e.g., noise level too high, improper ventilation, too distant from new colleagues or other necessary equipment/supplies, etc.).*

Along with new responsibilities, new colleagues and new skills, the future will also be different. Employees usually can see what the future holds in store and they work toward specific goals or aspirations. All the changes will affect the future. Career patterns may change. The employees have to be aware of this as well as make evaluations according to their needs or dreams. Channels of promotion may change so they will then have to learn the new channels and be aware of how it will affect their careers and self image. At times automation can bring about a change in job security. Security may be increased or decreased. A sterotypic view is that people are being replaced by machines, but machines always need people to operate them. So employees must be made aware of this difference and how it impacts on their own life/career.

Salaries or earning power may also change. New technologies and newly learned skills may mean an increase in salary and also in

*An interim Steelcase study does show workers feel jobs improved.

future earning power. For others it may mean a salary stabilization. This is an extremely important issue and could result in a number of consequences. People could feel more appreciated, more motivated and consequently more involved; or people could feel they've been shoved aside and this could lead to morale problems.

Along with new skills, new responsibilities and, perhaps, an increase in salary, one may gain prestige. Rather than presenting the new job as maintenance work, one should be made aware of the importance and challenge of his role in the new process. This will also avoid morale problems.

The facility as a whole may find it more cost effective to operate around the clock. This may apply to one or more departments or the entire work force. This means a number of factors will have to be considered, both in terms of the individual employees and in terms of the physical operations, e.g., security, heating costs, electric bills, safety, etc. Poeple who worked only during regular working hours will have to change their life styles, and it will require another major adjustment. If too many people insist on working only during the day, management will have to make some difficult decisions. They may be forced to let people go even though they simultaneously have to hire new people. Along with new hours, workers may also have to accept new jobs/assignments.

With automation and, possibly increased working hours, the volume of work may also increase. The consequences will impact on both

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workers and overall operations. Employees may find they have more to do because their work volume has increased. This should be accompanied with increased compensation so workers will not feel they're being taken advantage of, or that managers are insensitive to their situation. With the aid of machines, increas work loads may be manageable, but supervisors must be aware of any discrepancies.

The impact of automation is very different for blue and white collar workers. In some instances, the results are opposite. When factory workers are involved with an automated facility, it was discovered that in general their jobs were expanded. They were assigned to more tasks because they had more time and could give more attention to other tasks. Office workers on the other hand, found their jobs seemed to diminish. The cause may lie with management, in that they don't re-evaluate the work processes, or with the characteristic of the job, i.e., workers do less manual work but must still actively monitor the automated machine or other responsibilities (i.e., answer telephones, rec people) prevent them taking on additional tasks. It may be that office work processes have not yet been studied as intensively as factory work processes. When office work catches up, this difference may no longer exist.

Regarding satisfaction, factory workers usually become more satisfied while office workers become less satisfied. Studies sho this to be true but didn't provide an explanation for it.

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Factory workers may feel their jobs are more challenging, less boring, more important, more rewarding, safer and more secure. Office workers, on the other hand, may feel they are mere machine operators, are given less responsibility, are in a less secure position, have too little work to do, are more isolated, are less valuable or easily replaced and hence more alienated.

An interesting trend is that factory workers are being given more office type work and yet office workers are getting more factory type work. This, too, could lead to job dissatisfaction on the part of the white collar worker while the blue collar worker is experiencing an increase in job satsifaction.

A common element for both kinds of workers is that jobs are less secure. This could be merely an impression, or could be due to a worker's inability to adjust or learn new skills, or the worker is in fact being replaced by a machine. In any event, job security is a very real problem.

Personal contact is restricted for both types of workers. This is true because of the pace of work and the maintenance required. The work volume may restrict personal interaction. More attention must be paid to the operating procedures of the machines and since the machine works at its own pace, a worker must wait for an appropriate moment to stop. And among various workers, the chance of everyone stopping simultaneously is not very great. So, visiting time may be reduced as a consequence even though it was not intend

Or, breaks may be more regimented and controlled. Blue collar workers maybe more accustomed to this and react less negatively and adjust more readily than white collar workers.

Another situation which both types of workers share is that there are fewer opportunities for promotion. The reason for this is th- when automation leads to a reduced work force, there are fewer supervisory positions. Such job stabilization can be problematic in terms of morale, self esteem, earning power and motivation. It's a fact of life one must be cognizant of, and also to be aware of the probability, whether it highly probably or unlikely.

Automation can impact on the workers' life style and family life, whether they are blue or white collar workers. If shift work is introduced people may find they have more money but less time to spend with their family. They have to figure out what their priorities are, if they have a choice. Factories have been operating on a 24 hour basis for quite a few years, but it's relatively new administrative offices. Office workers must be educated as to how this will impact on their lives. Some very major decisions will be required of all workers.

In order for people to function efficiently, a certain amount of equilibrium is required. The amount varys among individuals, but most workers must feel some stability in their work environment. Because of the technological changes, work patterns will be disruptive and people will function less efficiently. All workers are subject to this, but the situation can be minimized

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by proper introduction of new systems and proper training/ education.

All workers can adjust to changes, but they require continuity, some stable basis from which to proceed. With all the rapidly developing technologies in the field, change is perceived as never ending and even accelerating. This is a difficult situation with which to come to grips. Again, management can make it easier and eliminate some trouble spots if they are sensitive to the workers and help them adjust to their new working conditions.

As with all situations, there are both pros and cons. With automation, this is true for the staff and also true with respect to the machine. When drawing up a list of pros and cons, the number of items on one side or the other is not the only thing to consider. Even though there are more cons, for example, it may be that the items are less significant than the few pro items. Also, what appears to be a disadvantage to one person may be an advantage to someone else.

Generally, some of the pros of automating the work environment are: greater accuracy, increased speed, greater productivity, greater volume of work and easier physically. The disadvantages, depending on the point of view, are: more demanding work or mentally more difficult, greater attention is required, must be more alert, more thought is involved, more anxiety about consequences of each step of the process, more risky (errors cost time and money) and the psychological and social consequences (e.g., less personal interaction, alienation, new life style, etc.).

When a facility is automated, the staff also views pros and cons but on their own terms. The positive aspects are:

1. the new environment,
2. more interesting work,
3. increased productivity,
4. more challenging job,
5. a team approach effort evolves,
6. advancement, mainly for programmers,
7. increase efficiency, and
8. pride in the new facility.

The disadvantages of the automated work environment are:

1. greater exposure to risk on new tasks,
2. more rigid performance standards,
3. increased work measurements,
4. remote or uninterested supervisors,
5. bleak future, less job security,
6. anxieties brought about by all the changes,
7. re-division of labor,
8. less individuality,
9. jobs or responsibilities stagnate,
10. for office workers, atmosphere is like a factory,
11. increased noise and heat to the point of discomfort, and
12. increased frustration.

Some of the positive points are not realized or perceived immedi and conversely, some negative points are realized right away but hopefully are short lived. In any event, they are not intrinsic

to every situation and may be controlled and/or eliminated or enhanced, which ever is appropriate.

When automating, there are certain requirements which must be met. The system must be formalized. A work structure must be established both to decentralize and centralize different functions. Deadlines and assigned tasks are very important for the individuals in a team and for the teams as a whole. Without it, the work cannot be accomplished efficiently. Standards of performance must be adhered to rigidly. Operations procedures and "work simplification" must be clear and apparent. Personnel must be flexible so they can be rotated to different tasks. This creates a more flexible and hence more efficient system. Fewer absences are important in order to reduce the amount of disrupted work. This is true for tardiness, also. In a team work situation, there is a greater degree of personal contact among team members. Consequently, proximity to colleagues is an important aspect of working conditions. This should lead to the proper environment, "open landscape" vs. closed offices. Usually, teams work best in modular type of offices, and not private offices. Even though workers may lose their sense of individuality, a greater degree of interdependence is formulated and the group or team becomes more integrated -- a common requirement and advantageous for more efficient automated systems. At least the means for greater integration, when appropriate, is available.

The psychological and organizational impacts upon the working environment is significant and complex. The same is true for the

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individuals in that working environment. Managers and workers must both adjust to all the changes going on around them, but their experiences are different. The two experiences can be easily contrasted when examining the new, automated typing systems -- word processors.

Even though bosses don't use the word processors -- secretaries do -- their work lives have undergone change also. Typing systems have been updated, and so have dictating systems. The new systems have impacted on one another while striving to be more efficient. The new dictating systems are not always viewed favorably by bosses who don't want to relinquish their personal secretary. Also, there is more exposure to more unknown people. It took a while for managers to adjust to talking into a machine, even when they knew who they were talking to. Now, they talk into a machine and some time later their spoken words have been turned into words written on a piece of paper lying on their desk -- it is as if the machine did it all, no other human being was involved. But they know their voice is traveling down to some room full of people with earphones plugged into a machine, sitting with fingers poised over a keyboard. Yet all of these people are unknowns -- numbers or initials typed on the bottom of a page. Prior to this, when he dictated to a person he could watch for expressions to know if he was making sense, or he could ask if it was clear. Now all the jumbled sen-

tences go right straight down to the pool; this produces a lot of anxiety for some people but also wastes a lot of time. Letters require extensive editing or re-writing, or both. In order to assure top efficiency, some companies provide the letter writers with courses in how to dictate. People are working in more isolation and feelings of alienation can develop. The training courses can satisfy a dual purpose: improve dictating ability and show the employees the company is aware of them and cares.

This type of dictating procedure also seems to be rigidly democratic -- first come, first served. But what does one do when time is of the essence? Is the system flexible enough to take work out of the queue and not just wait till it shows up? Who establishes or authorizes priorities? Would the original typist get follow-up work, or must initial instructions be submitted every time? Can writers request specific typists or is this not allowed? If not, what other kind of feedback exists to evaluate the typist?

After the work has been dictated, it is submitted to the typist. They share some of the problems of the writers: experience, alienation, inability to express preference for some writers over others; incontinuity -- inability to see a task through to completion, or assigned to work on a task which someone else started; and inability to provide feedback evaluating the writers. But the world of the typist has changed drastically. The typists have to rethink their own work processes. With the word processing system,

one very basic element which must change is the attitude toward accuracy. Before word processors were available, accuracy was considered the most important criteria and speed the second. After word processors were introduced, the typists were told to disregard accuracy and work for speed. Everything was to be typed as draft copy because the machine was designed to type the final, 100% accurate copy. So the typist works on rough, draft copy; the machine produces the finished copy. The operator must reorient his thinking and ingore the number of mistakes he makes. Mistakes have to be corrected, but how many he makes doesn't matter.

Besides adjusting attitudes about speed and accuracy, the typist must analyze different work procedures to determine what the machnine should do and what the person should do. A lot of tasks are performed almost subconsciously. A person must become aware of them and then determine if the machine should do it. A very simple example is returning the carrier at the end of the line. Up until now, there was only one way to get the carrier to return -- manually hit a key or bar; the typist had to return it. Now with word processors, the return can be either automatic or manual. A typist who has always done it manually usually continues to do so, or tries to, with a processor. The result may, depending upon the system, prevent the machine from following the desired format or start a new paragraph

when it's inappropriate. It may merely startle the typist when the machine does something unexpectedly, returns "by itself." Or, when "playing out" final copy, the machine may incorrectly begin a new line and then the typist will have a difficult time trying to figure out why because he's unaware of having hit the return key. So he may spend a very frustrating few minutes trying to discover the cause of the mysterious behavior. It is times like these that the machine seemingly exercises enormous power, and even "takes over" and does what it wants. After the typist has learned that the machine will automatically return the carrier, he then waits while the machine does it -- not realizing the speed at which the machine performs the task or its storage capability, the machine will take in commands faster than it can execute them and perform them in the proper sequence. The problems which result from the typist hitting the carrier return may be nothing more than frustrating or startling, and they are usually short lived. For a short period of time the typist will be going through some changes and adjustments, which will not be too taxing. He simply may not be his old self.

If the system has a graphic display terminal, the operator must adjust to a different visual field. At first the typist may feel very estranged and alienated from his work. Prior to this the product was tangible and accessible; now it has taken on an abstract quality. No longer can he reach up and

erase a letter or word, or just "rip the paper out of the machine" and start all over. Some typists object to the remote aspect of the system and are uncomfortable because they feel they are no longer in control. Others quickly become aware of all the advantages and are not disturbed by the new format. In addition to adjusting to a new visual image, the typist must learn how to interpret that image so he can correctly anticipate how the finished product will look so it will coincide with his expectations and desires.

Other word processor systems use paper, like a conventional typewriter, rather than a screen. In this situation the first thing a typist can do is throw away the correction fluid and tape. For most typist this would provoke a great deal of anxiety. But remember, he is only typing rough drafts; if a mistake is made, the correction is typed right over the mistake. On the magnetic tape or card backspacing erases what was there. In order to see the typed correction he can simply roll the platen down, vertically. That maneuver won't be recorded and he can see what he retypes. So the solution is simple but one must reorient his thinking and also be a bit creative. In this system, most everything that is typed will use at least two sheets of paper. A sheet is used to put the material "into" the machine, corrections are made, usually on another sheet and then a third sheet is used for the final copy. If there is another

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change to be made, or while playing out the final copy one discovers something that was overlooked, that change must be made and another, fourth or fifth sheet is used. Where a typist may have used one sheet, on a good day, with a conventional system, now two to five sheets are used. In the conventional system one tried to "get it right the first time." So, when one begins using a word processor he usually feels very guilty about the amount of paper he's using. The wastebasket gets filled very rapidly.

In certain instances, a disadvantage with the new electronic typing systems is the increased noise level. This is predominantly due to the high speed printing element on an impact printer (a thermoprinter or ink set printer is relatively quiet). Manufacturers are aware of the problem and are trying to find a solution. Some have redesigned the printer; some have provided sound hoods; others have developed a remote printer which is located away from the typist, even in other rooms or on different floors. Other problems may be created (e.g., alienation or inconvenience due to distance) and a choice has to be made as to the best solution for each individual user.

In terms of the desk arrangement or work space, no longer is there one simple machine to consider. Now there are component parts to deal with, tape/card console, keyboard, screen, printer and storage space for supplies, which has

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also increased in volume (magnetic tapes/cards/floppy disks, new and used; file system for the used one; ribbons for printers; paper for hard copy of the work in progress and work completed plus files for hard copy). If the new electronic machines are placed in a conventional work space, it is usually not compatible. Typewriter runoffs may not be deep enough and/or too long. As a consequence the machine could prevent the center drawer from opening, and the added length makes it necessary to stretch to reach the tape/card/ disk console everytime one interacts physically with the console (i.e., putting in a tape or resetting the machine). Both the work space and furniture must be reevaulated in terms of new requirements. When redesigning the existing facility, one must not assume conventional concepts will be compatible with new automated systems. It would be wrong to solicit ideas about the new work stations from workers who've not used the electronic systems. Until they've gained hands-on experience with the automated systems, their ideas will be inappropriate and naive. Some manufacturers of electronic machinery offer furniture with their machinery. However, such products -- although good -- are not necessarily compatible with other furniture.

Individual work spaces will change internally and externally with regard to their relationship to other work spaces. Because of different space requirements, furniture requirements and working relationships, the working space of the new equipment must be reevaluated. The new system may require

more space than the equipment it is replacing. Also, working relationships may change and it may be necessary to relocate the area so appropriate personnel will be in close proximity.

Finally, one may find he is calling the manufacturer's representative much more frequently. This is true for two reasons. One the machine is much more complicated and customers are discouraged from "repairing" the machine themselves. Second, the operating methods are more complicated and the workers may find the salesman or repairman a good source in discovering how certain problems may be solved, or how to perform some functions more efficiently. The worker must not feel dumb because he calls the manufacturer so much. And, the manager/supervisor must not be concerned if he sees a repairman more frequently.

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COMPUTERS AND HOW THEY WORK

COMPUTERS AND HOW THEY WORK

Computers are revolutionizing our world and we're unprepared for it. Myths inhibit our preparation, e.g., they're costly, overwhelmingly complicated, difficult to learn and sacrifice jobs/people. But costs are dropping drastically and the myths are being eliminated. Computers are becoming very commonplace in the work place. Home use is on an incline and computer stores are cropping up all over.

Computers are widely used in all facets of our life. In business there are electronic typewriters, magnetic communiques, up-graded telephone systems, information storehouses, audio controls, appliance controls, temperature controls, schedule planners and music synthesizers.

Originally, in 1946, the computer was developed to work through large arithmetic problems. The possibility for individual work was overlooked. IBM wasn't even interested in these new machines because they felt their calculators were fast enough. In the 50's the business world adapted the computer to satisfy their bookkeeping requirements.

In the 60's companies worked to develop a machine which would combine the scientific computer with the business computer. IBM designed the 360 which they hoped would do everything. For a while it knocked out competition. Its complexity insured customers' dependence on IBM.

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Customers had to be trained by IBM just to work the machine.

The business world is confused because they believe computers are what IBM used to say it was: enormous, horrendously expensive and requires the service of a band of devoted priests. But computers are nothing more than the arrangement of electronic circuits. That arrangement determines the function it will perform.

Silicone has been extremely important in the evolution of the computer. It's used to fuse the integrated systems. Wall size maps of the circuits are photographed and reduced and become patterns for the circuits on silicone chips. The circuit lines are smaller than the lines of a fingerprint. These chips were essential for the development of "mini" and "microcomputers." Their reduced size and simplier operation made computers available to a larger market, i.e., small businesses, homes and hobbyists. These "microcomputers" or silicone chips will expand computer use drastically in years to come.

Here, it must be understood that once an integrated circuit is designed, the manufacture depends only upon a "stamping" machine, that is one of the reasons computers are becoming less and less expensive as volume increases. The wiring and circuitry can be mass produced easily.

Now that computers are becoming more commonplace, the myths must be broken down. People must become more comfortable with them. One major problem is the idea that computers control people or businesses. The psychological ramifications of this are obvious. The Big Brother, or "1984" situation immediately comes to mind. Another misconception is that people won't have the freedom to do things their own way, and most doubt that another way is better. Also, they lose control, which may mean power or money. They believe, and have been told by misguided souls, that once the computer does it, it's final and must be right -- or else the computer wouldn't have done it. How many times have we heard, "I'm sorry, the computer can't answer that", or, "the computer made a mistake."

We must bear in mind a computer is only as good as its operator or programmer. If the answer is unattainable, it's because the answer was not put in the machine, or the means to obtain it was not put in, or the operator doesn't feel like working that day. If the answer is incorrect, maybe someone gave it improper information or directions. Even though this makes us more accountable, the fact that computers are not omnipotent gives us more control and makes the computer appear less awesome.

Now that we are putting computers into proper perspective, let's see how they really function. Computers can be compared to the brain of humans. Computers perform arithmetic

and logic functions, as do humans, but performs them much faster. Both people and computers have memories, but the machine's is physically limited and predetermined by electrons and circuits. People can, through training, increase their capacity to remember and the number of "memory cells" a human has, or the physical limit, is unknown. Besides, people, not computers, have minds. Comparisons can be made by each , but only people can make value judgments. Computers can only do as they are told. They cannot be programmed for serendipity.

Computers, then, are merely blank machines waiting to be told what to do. But how do we tell them? How do we know what they can do? The computer program is a set of instructions which when followed will produce a specific result. We must store in the computer programs which will enable us to use the computer. Most computers are delivered with programs which enable us to communicate with it so we can enter more programs so it will do what we want. The programs must be composed of thoroughly thought out steps because the computer works sequentially. No step can be left out or ambiguous because the computer does not assume anything -- it does exactly what it is told. If the program doesn't work, each step must be examined to see where the faulty instruction lies.

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But how does someone "program" or tell the computer what to do? First, remember that the computer is an electronic machine, which means electrical impulses transmit the information. The arrangements of these impulses represent numbers. Since electricity is either on or off, only two numbers, zero for off and one for on, can be used in the base system but these two numbers can be strung together to signify more than just zero or one -- just as when "ten" is represented by a zero following one in our decimal system. The representatives zero and one are called "bits," for binary digit. When the bits are strung together they are called a character. In any given computer, all the characters have the same number of bits. Determining this number produces a code. This code is the computer's language.

There are actually thousands of different computer languages, but about 24 are traditional or more commonly used. There is no single, universal language. The reason for the number of different languages is to provide flexibility and the ability to communicate and work with others. If each computer facility developed its own language to satisfy its own requirements, it would be impossible for programmers to learn all the languages in order to work at different facilities. So workers could not draw on outside assistance nor could they easily relocate to better positions. If there was a single, universal language, it would be too inflexible and the applications too limited. Each of the

traditional languages satisfies certain basic requirements and also allows programmers to communicate easily with one another, with both in-house and outside programmers. For example, FORTRAN simplified the programming of algebraic formulas while COBOL was devised for business applications. If programmers know COBOL, for instance, they have a common language with which to communicate and the language enables them to express in business terms the steps the computer is to follow. BASIC is the most commonly used language and it's very similar to English. There are different versions of BASIC -- each computer manufacturer uses a different version. Because of its relatively simple nature, switching from one to another is not too difficult.

When a computer language is learned, or while learning a language, one can learn programming. The most efficient way to learn is to do it. Bearing in mind that a program is a set of instructions which the computer follows to deliver the desired result, one must determine three things:

1. the kind of information, data, that will be put into the computer;
2. the data the computer will provide; and
3. what steps the computer will follow to obtain those results.

At first it looks as if you will be doing all the work. You have to provide the data the computer will work with; you have to know what you are looking for; and the computer

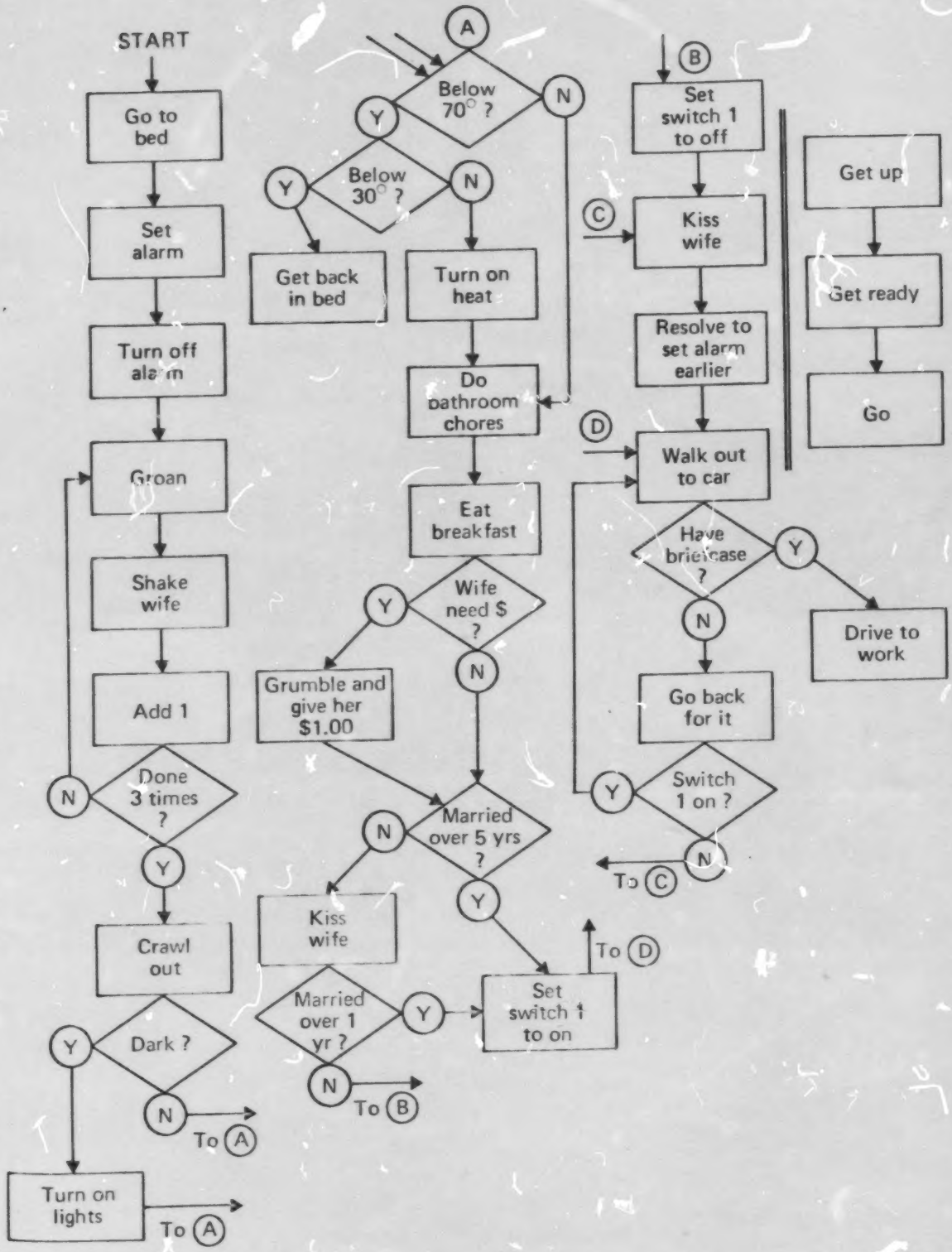
will only do what it is told so you have to know each step it will take to work through a problem. The advantage is that the computer works faster and with fewer errors. The easiest way to work through such a thought process is to write down all the procedures in the form of a diagram -- a flowchart. A flowchart is a map of the program that is being written. Standard symbols are used so each step can be interpreted instantly and others can easily read it. The symbols also enable the programmer to visualize the procedures. Examples of some of the symbols are: a rectangle signifies a processing step, a diamond signifies a decision point, and a circle signifies a connector. An example of a flowchart is on the following page.

Once the flowchart has been drawn, the program can be written. The particular computer being used will require that the program be written in a specific way. The computer manual will tell you how the program should be written and will provide examples of how a program appears. A collection of programs is referred to as software. The software which the manufacturer supplies with the machine is sometimes differentiated from the software the user puts into the machine. The first is the system software, the other is the application software. Some prefer not to make such a distinction and they consider all programs to be software.

Regardless of the application or language that is used, some programming situations are inescapable. For example it's natural to make mistakes, which are called bugs. To correct the mistakes is to debug the program. More experienced programmers make fewer mistakes, but mistakes are inevitable and hard to find. It's difficult to see mistakes just by looking at the program. The program must be run to see what the problems are and then corrected. Some bugs may be buried deep and not be discovered for quite a while. In this kind of situation, the program may run successfully many times and then "suddenly" fail.

As programs get more complicated and bigger, the problems also get worse. Solving problems or debugging a program can be very tedious. Once in a while the programmer receives a reward, but a great deal of time and effort can be spent in between rewards. A trial and error method is used to solve problems. Behavioral psychologists say this is the most effective learning situation. Programmers generally enjoy games and the challenge involved in problem solving, and the nature of debugging requires such a nature.

Debugging can be costly and time consuming and there are a couple of ways to avoid this. One is to use structured programming, which is to divide the programs into blocks which behave and interrelate in certain ways. The



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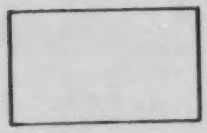
Basic Flowchart Symbols

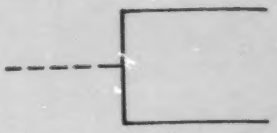
Input/Output

Process



Flowline

Annotation



Specialized Input/Output Symbols

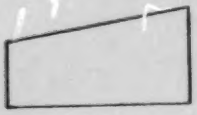
Punched Card

Magnetic Tape

Punched Tape

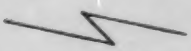
Document

Manual Input



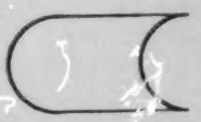
Display

Communication Link



Specialized Process Symbols

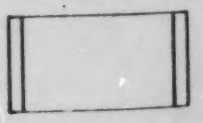
Online Storage



Offline Storage

Decision

Predefined Process



Auxiliary Operation

Manual Operation

Additional Symbols

Connector

Terminal

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advantages of this programming is that it's easier to debug, cheaper to produce, and easier to improve or update.

Another way to avoid the problems inherent in writing a program is to buy or rent a program. The cost is determined by what the market can bear. In order for this to be cost effective, one must estimate the cost of writing it and compare that cost to the price or rental fee of the written program. Pre-existing programs will have to be adapted to the specific needs and this cost should also be considered. Buying or renting programs is quite common in business situations. Programming companies, or software houses, exist to perform this function. Sometimes software houses sell programs with the condition that you also purchase/rent the necessary equipment.

We now know generally how a computer works and that it is waiting to receive a set of instructions -- via the appropriate language and software. But how does one physically communicate with a computer? The machines used to put information into the computer and/or send information back out are called input and output (I/O) devices. Data first passes through a port which converts the information to a form the computer can process or the user can understand or read, depending on the process involved. There are a number of input devices available, but the most common is the keyboard which resembles a typewriter. This enables the user to use letters and words to input data and one

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can see and easily understand what they are working on. This device can be used for output as well, which makes operating the system easier and sometimes more economical. The display units can be video displays (like a television set), an audio device (an example is the computerized voice simulator that tells a telephone caller the correct time), or printers (such as the IBM Selectric II typewriter). The audio devices are highly developed as far as output is concerned, but more work is needed for input. The video displays, referred to as CRTs because they use cathode ray tubes, serve a dual function -- both input and output. The disadvantage of this system is that no permanent record (hard copy) is available. Another piece of equipment is required. Depending on how the computer is used, hard copy may not be necessary and to always have hard copy may be an unnecessary expense. Printers can also provide input/output capability and simultaneously provide hard copy. But noise may be a disadvantage with this system, if an impact printer is used. A jet spray or thermo printer makes substantially less noise.

What can we expect from a computer, now that we are in full operation? To determine this one must be aware of the limits and/or capabilities of the computer. Any other limitations will be due to the user's imagination and creativity. Some of the basic uses of a computer are: record keeping; library functions, such as acquisitions,

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cataloging and circulation; and accounting procedures, where daily inventories, up-to-date accounts receivable, expenditures, sales and production data are recorded. Commercial mailing lists are usually computerized. Word processing systems utilize computer concepts; so does electronic filing.

Some of these systems simultaneously produce hardcopy, store information in the memory and send information on telephone devices half way across the country.

A computer system may be a "main frame" (large central processor) and many terminals, or a network of several minicomputers that are capable of searching one or another's memory. The system may be dedicated to only one function or multifunctional. The latter depends upon many peripheral devices. They may be small (such as hand-held calculators) or large (requiring their own "clean rooms"). But whatever they are, we must understand that they will be ever more commonplace in this very complex world.

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GLOSSARY

ACCESS TIME: the time it takes to obtain data from the time it was requested.

ARCHITECTURE: the structure of a computer system -- the physical hardware, the manner and order of processing, the arrangement of the elements of a computer.

ASSEMBLER: a software program which converts symbolic language into machine language.

BASIC: a high-level programming language that is very popular because it is relatively simple to use and resembles the English language. Others include FORTRAN and PASCAL.

BATCH PROCESSING: when data is processed some time after it was originally submitted.

BENCHMARK: a test program or problem which is used to compare computers; the criteria may be speed, memory requirements, costs, ease of programming, etc.

BINARY: a number system that has 2 as its base and uses only the digits zero and one. The basis for all computer circuit

BIT: contraction of binary digit.

BIT RATE: the number of bits transmitted per second.

BUS: a conductor or set of conductors used to transmit data, signals, or power between parts of a computer.

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GLOSSARY

BYTE: Eight bits. Most microcomputers use data words of eight bits, so in microprocessing a byte is generally synonymous with "word", a computer word or character.

CARD: a punched card or a board with a printed circuit.

CATHODE RAY TUBE (CRT): an electronic vacuum tube, such as a television picture tube, used to display graphic images.

CENTRAL PROCESSING UNIT (CPU): the heart of a computer system, it handles the decoding and execution of instructions, controls the use of memory, performs arithmetic functions, etc.

CHARACTER: anything that is used to represent, organize and transmit data; it may be a letter of the alphabet, a digit, a punctuation mark, or any special symbol (e.g., a plus sign or equal sign).

CHIP: a very small silicon wafer containing an integrated circuit.

CODE: a set of unique symbols used to represent data, and the rules specifying the way those symbols may be used.

COMPILER: a program which converts a program written in a high-level language into machine language...a macro-assembler.

CONSOLE: the control panel which permits the operator to use the system.

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GLOSSARY

CONVERTER: electronic circuitry or device which converts data from one form of storage to another -- mag. card to tape,

CORE MEMORY: a main storage device.

DATA: information.

DATA BASE: the total quantity of information. Similar to a file.

DATA PROCESSING: mathematical procedures followed by the computer.

DATA RETRIEVAL: bringing data from storage so it can be used or processed.

DEBUG: to find and correct an error which caused the system to malfunction.

DEDICATION: to assign a program, I/O device or the entire system to a single application or purpose. Telephones are dedic

DISK: a plate resembling a phonograph record used to record data; "floppy" disks or diskettes are more flexible and less costly disks. Many allow random access.

DOCUMENTATION: all the written material necessary to operate the system.

DOWN: when the computer is not functioning.

DUMP: a print-out of the contents of a section of memory.

EDIT: to change portions of a program or the data.

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GLOSSARY

EDITOR: a program or section of a program which enables the user to edit.

EDP: electronic data processing...rather than manual processing.

FIRMWARE: a program implanted in a read-only memory.

FLAG: indication that a particular condition exists.

FLOWCHART: diagram depicting the sequential steps of a program.

HARD COPY: output printed on paper. (Books are hardcopy, as are print-outs.

HARDWARE: the physical components of a computer -- the electronics, the wires, the pastic, the glass and the metal.

HIGH-LEVEL LANGUAGE: the language a programmer uses, as opposed to the machine language.

INPUT/OUTPUT (I/O) DEVICE: peripheral machines used to put data in or take data out of the computer, e.g., terminals or printers.

INTEGRATED CIRCUIT (IC): a complete electronic circuit contained on a chip.

INTERFACE: the point where two pieces of equipment meet.

K: used to represent one thousand, e.g., 8,000 bytes = 8 Kilobytes = 8K. Computer memories are rated by the number of K.

KEYBOARD/KEYPAD: the typewriter portion of an I/O device.

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GLOSSARY

LANGUAGE: a system of communication that uses a set of fixed symbols according to specific rules. BASIC is a language.

LOAD: enter data into a computer.

MACHINE LANGUAGE: the only language the computer understands.

MAGNETIC TAPE: recording tape, sometimes referred to as "mag" tape.

MAINFRAME: the central processing unit.

MEMORY: where data is entered and stored.

MICROCOMPUTER: a small computer whose CPU is an integrated circuit embedded in a semiconductor chip.

MICROPROCESSOR: a CPU comprising one or several semiconductor chips. A microcomputer has a microprocessor and a I/O.

MINICOMPUTER: a "medium" sized computer -- bigger than a microcomputer but smaller than a big computer.

MODEM: a device that converts data so it can be transmitted over telephone lines and then reconverts the data at the other end.

NUMBER-CRUNCHING: a computer designed to perform large quantities of arithmetical computations.

ONLINE: a peripheral unit operating in conjunction with a computer. In some instances implies connection through telephone to someone else's computer.

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GLOSSARY

OUTPUT: data the computer transmits to a peripheral device.

PERIPHERAL: devices which work in conjunction with the computer but are not part of it.

PRINTER: devices which deliver hard-copy print-outs of processed data.

PRINT-OUT: output of a printer.

PROCESSOR: a program which provides for compilation, translation and various other functions of a specific programming language.

PROGRAM: a set of sequential instruction designed to achieve a specific result.

PROGRAMMER: a person who designs, writes and tests programs.

PUNCHED CARD: a card with holes which represent letters, digits and special characters and used to transmit data into the machine.

READ-OUT: a display on a visual device.

REAL TIME: when data is processed as soon as it is received.

ROM: or Read-Only Memory, i.e., computer memory which can be read but not written to.

ROUTINE: a set of instruction -- a program within a program.

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GLOSSARY

SOFTWARE: a computer's program.

SYSTEM: a group of elements that interact to form an entity.

SYSTEMS ANALYST: a person who analyzes systems in order to improve them or solve problems.

TIME SHARING: when two or more users use the same central processing unit.

RANDOM-ACESS MEMORY (RAM): computer memory that has been arranged into cells, any one of which can be "accessed" directly.

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HUMAN FACTORS

HUMAN FACTORS

Human factors, human engineering and ergonomics relate to the man/machine interface - - the physical and sometimes psychological ramifications of working with machinery. Surprisingly, although the field of industrial engineering has long been involved in the man/machine interface in factories, few white collar studies have been done. Several of the leading computer manufacturers have done their own studies -- but even these are few and far between. The following discussion was excerpted from an IBM in-house publication called "Human Factors of Workstations with Display Terminals"

A. VISUAL DISPLAY CONSIDERATIONS

Among the factors that should be considered in the selection of any terminal are the size and angle. Obviously the usable part of the display surface should be large enough for the intended maximum number of symbols in legible size and format. The angle of the screen and the tube within allow the user to read the display.

The tubes within the display can be susceptible to distortion and cause definite viewing problems. Longer tubes have the advantage of improved image quality. On the other hand, longer tubes tend to increase the depth of display. Depth of display and image quality both modify seeing ability. Here, then, is one tradeoff that is made in the choice process.

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Flickering is a very annoying problem when dealing with displays. Human factor considerations here depend upon the persistence of the phosphor chosen for the display. If the phosphor image persists too long, remaining long after the electron beam has ceased, an after image will appear. On the other hand, a short persistence must be "excited" many more times per second. This will tend to make the screen flicker.

On a normal TV set, and a CRT screen is nothing more than a video display with some TV innards removed, a short lasting phosphor is necessary. Otherwise the motion will "smear." But on display terminals, long lasting phosphors are chosen. Display terminals usually require more static images. Blurring due to motion is less of a problem. (However, the phosphors can be blended so that the exact persistence one desires can be found.)

The number of times per second a point on the surface of the CRT is re-illuminated by an electron beam is called the refresh rate. An overly fast refresh rate adds expense and complication to the circuitry. However, if the refresh rate is not fast enough, it will also cause flicker.

Flicker is caused by a number of other factors, including: ambient light levels, symbol brightness, symbol density, display size, etc. For one employee the screen may appear to flicker, while for another, it may not. It is very

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subjective.

At this time there does not appear to be a valid method of measuring how bright displays are in relation to the human eye. Under very short time duration an ophthalmological law known as Bunsen-Roscoe seems to hold very well. The law implies that a 100 candlepower light on for 10 milliseconds will look just as bright as a 200 candlepower light on for 5 milliseconds. In other words, the longer one views a light source, the brighter it appears (at least in short duration). The longer one looks at a message on a display terminal, the more legible it may appear.

Color is important for display terminals. Under certain conditions, as when the display is to be used with very low ambient light levels, color improves the legibility of the screen. People who are a bit farsighted find it easier to focus on red wavelengths than blue, while the opposite is true for people who are a bit nearsighted. Reflections caused by ambient light hitting the surface of the CRT tend to rove toward grey levels. Thus, it is easier to distinguish symbols on the screen if they differ from the reflections in color as well as brightness.

Light reflected from the display screen depends upon the nature of the surface of the screen and the angle at which it strikes. For example, about 40% of the light that strikes a smooth untreated glass surface at a 50° angle

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is reflected. The percentage increases as the angle increases. It is usually impractical to try to eliminate all reflected light. Instead, an attempt is made only to reduce it to an acceptable level. The methods most often used are to reorient the screen, angle the light away, baffle the light or use anti-reflective coatings on the screen.

Special anti-reflective coatings may be deposited on the CRT display glass during manufacture. The coatings work so that the light waves reflected from the surface are now out of phase with the message on the display. This interference cancels the reflected light. The coatings are usually applied in several layers to reduce reflections by 90% or more without any distortion or blurring of the screen image. Unfortunately, a problem with thin-film anti-reflection coatings is one of dirt and fingerprints. They become more noticable. Hence display screens may have to be cleaned more frequently.

To prevent reflection, hoods that wrap around the task area are not recommended. To be effective they usually create an awkward task area. Re-orienting the screen is a better idea.

Character size on the display screen also has an effect upon the ability to see. The size of the characters with respect to the length away from the eye is more important than absolute size. IBM suggests character height should be no less than 1/200th of the viewing dis-

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completed and the keyboard locked. Now the same information has to be built in or compensated for in design. Audible "clicks" to indicate by signal that keys have been struck must be built into electronic keyboards. Electronic systems do not have such clicks.

Rapid keying is a complex psychomotor process. A stream of signals is sent to the brain to control muscle activity. Several activities may go on at once: one finger may be completing a key depression while another is beginning the process. Meanwhile, receptors in the fingers send back signals to the brain that carry information about finger movement. The feedback must be correlated with what was anticipated.

Smooth keying depends upon the operator's ability to generate the pattern of motor signals and receive feedback so that a match may be made between intended and perceived ability. Yes, that's why the machine must cooperate in positive feedback -- it is important to accurate and rapid keying.

Keyboard layout

Long existing standards dictate the location of most keys. There are touch positions such as shift, return and backspace. There are home positions -- special keys and line space. Special function keys are placed by IBM in non-touch, non-home positions. Such special function keys include CLEAR. They should be struck only if the operator moves

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the whole hand out of position. They are out of the touch area because the company views them as keys that require verification before being struck.

Key mechanism

Efficient keying requires the keys to function with minimum adequate force and some displacement to provide some muscular feedback. The more proficient the operator, the lighter the touch. Too sensitive in touch, extra keys may be struck accidentally. Too insensitive to touch, some keys may not be actuated because one did not press hard enough.

Designed to be comfortable for the operator's fingers, keys typically have a top surface about 1/2" square on a 3/4" base and are slightly concave. Home position keys may be more concave than others so that operators can sense by finger touch exactly where they are. Keytops are given matte finish to keep them from reflecting light. This also makes their labels easier to read. Matte finish makes the key tops less slippery under fingertips.

Keyboard Packaging

Basic objectives in keyboard packaging are to minimize size consistent with logical layout and to create the proper slope for the hand. The first of these is important because it means more room for other items on the desk. Also minimizing the keyboard thickness and height permits better knee space and a comfortable seating position.

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The keyboard should slope 10° to 15° to allow good hand movements. The bottom of the keypad should be desk top height, or 30" from the floor.

C. WORKSTATION CONFIGURATION

The Chair

The one feature for a well designed chair is a good backrest. The backrest helps maintain inward curve of the lower spine and take some body weight off the spine. Good sitting posture results in even pressure on the spinal discs. One's head should not be excessively bent over causing an inward curve at the neck. There should be an outward curve of the spine at the thorax. About a 90° angle between upper and lower arms is preferred, with the upper arm being nearly vertical. There should be no pressure against the lower back of the thigh. The feet should be flat on the floor or footrest.

The shape of the chair seat is important. It should allow frequent changes of body position. People are rarely static for any length of time. Most of the body weight should be transferred to the seat through the buttocks. Weight transfer through the thighs should be avoided.

Too hard seat surfaces are detrimental. Pressure may be too concentrated and the operator will become uncom-

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fortable. If the seat is too soft, the sitter will tend to float and be unable to find a comfortable position. The seat should compress about 2 cm when someone is sitting for it to be reasonably firm.

Seat height should always be adjustable. No two people are alike. When one is seated, the thighs should be reasonably horizontal. The lower legs should be vertical and the feet firmly planted on the floor (or foot rest).

Work Surface -- Desk

Worksurfaces for a terminal are the keytops of the keyboard, display surface, surface of the source document (if there is any), the writing surface (if any is needed), and any body support surfaces. Each of these may have different requirements for a specific task. For example, proper keyboard location depends upon how often the keyboard is used -- and whether the keying activity is a one or two handed task. If one keys only rarely, absolute comfort is unnecessary. But if one keys for hours at a time, absolute comfort is a necessity.

Text entry (regular typing) usually requires equal use of both hands. The keyboard should then be directly in front of the operator. Data entry requires one hand for keying and the other for such activity as holding another document, a reference position, writing or manipulating documents. Here, it is best to place the keyboard directly in front of the keying hand and leave a large area free for the activity of the other hand.

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Comfortable keyboard height depends on arm position. If the operator is to be keying for a long time the upper arm should be nearly vertical while the lower arm is nearly horizontal. The hands may tilt up slightly to allow the fingers to travel freely over the core of the keyboard.

Display Unit Distance

In practice, most people seem to prefer viewing distances between 35 and 50 cm. The longer distances are recommended on the assumption it will lessen the probability of visual fatigue. It requires less visual convergence and accommodation.

THE ARRANGEMENT OF SPACE

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THE ARRANGEMENT OF SPACE

Real Estate Brokers, Architects, Interior Designers -- the professionals in the field -- tell us that it is not the quantity of space, but rather the quality which is important. Most of us tend to look upon this statement with a certain amount of suspicion; afterall, the professionals have something to sell, their commissions often are based on a percentage of costs. The higher the costs, the higher their fees. Besides, square foot costs form a part of the overhead, so our inclination is to spend as little up front as possible, as well as little per square foot we can get away with, while at the same time, getting as much as we can.

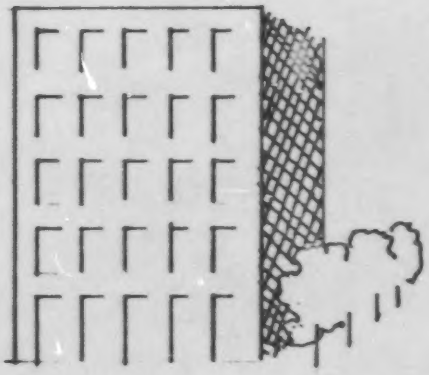
However, in the life cycle of a 20 year old office building, 90-92% of the monies spent go into employee salaries, 2-3% the actual construction cost, and a fairly hefty 6-8% into operating costs. Since operating costs, more often than not, have to do with the quality of space, it is our best interests to look for the best.

Of course, the professionals are talking about many things, things in which we may not be interested. Perhaps, they are speaking about the status of the office space, whether it is in a prime location on a prime floor (yes, office buildings as well as certain floors have status. There are those complexes located in the poshest business districts that are not only the most expensive but the most status laden of all). Or they may be referring to the "look" of the space, whether it is well appointed, and needs little renovation. In this workshop, we are talking about the configuration of space. When you think about it, it becomes obvious that certain companies require one type of floor layout, while others require another....and that often what is good for one firm is not good for another.

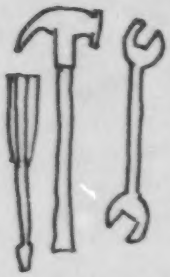
For example, lawyers, accountants, and such, tend to like large offices, fairly soundproofed (to guard their confidential conferences), buffered by secretaries

LIFE CYCLE COST OF AN OF

BUILDING OVER 20 YEARS



Construction Cost
2-3% for building and equipment



Maintenance Cost
7-8% for maintenance and repl

Staff
90-92% for staff salaries and be

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or assistants. The secretaries may be seated in their own small inner offices, guarding the door to the "executive chamber", or they may be seated in the wide corridors /walkways adjacent to their employer's enclosed spaces. In addition, law firms need a number of conference rooms, and a large area for a central library.

The so called "creative" firms, the advertising agencies, publishers, record companies, film producers, etc. often need many small individual rooms for their personnel to work alone, and a few large open areas for the art department. The banking industry as well as the insurance and brokerage houses require large open areas for many clerks and several good sized executive offices for higher managment. Offices connected to factory spaces need high ceilings for the factory spaces and good floor loading factors for heavy machinery. Floor loading is also of extreme importance for companies dependant upon centralized computers, as well as good air conditioning for the main computer room. Showroom/offices require large open spaces with as few columns as possible so as not to break up the space, while gallery/offices sometimes do not care whether there are windows at all, but do require excellent wall space as well as high ceilings to display their wares.

When choosing office spaces, whether in a leased or wholly owned situation, we find that it is best to choose the space on a module basis. Thus if one eventually wishes to increase or decrease the space within a period of time, by looking at the space as a module, one will know where the expansion or contraction can take place.

For most offices the best module is a square. First of all, the lighting system functions best in a square -- one light aids another --, and the acoustical system works best in a square. Besides per square foot there tends to be less peripherial wall space than in most other types of configurations. This last point

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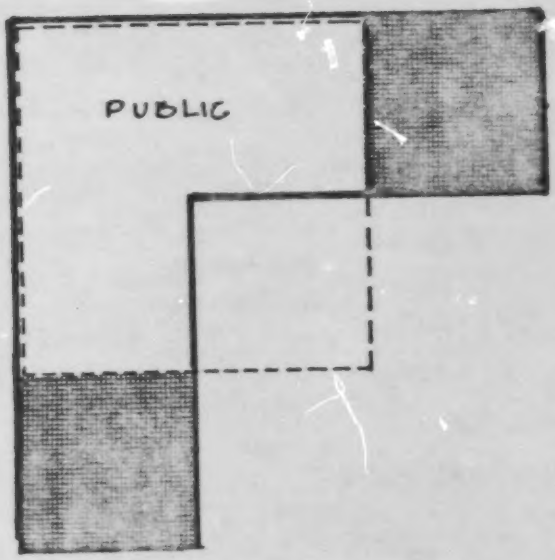
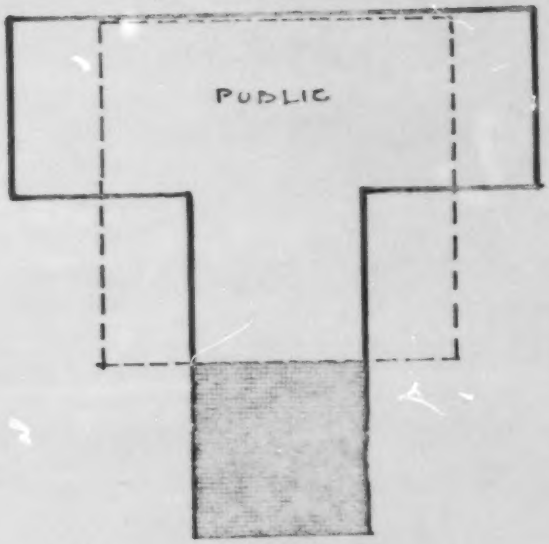


Square

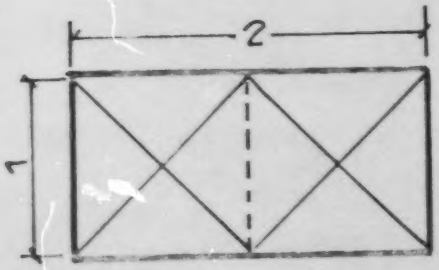
"L" shaped space.

To make the "L" shaped space more workable, draw an imaginery square over the center. The resulting square footage in the center should be used as a "public area".... the area where the most interdepartment traffic converges. The best entry to the offices is where the two corners of the "L" converge. The work entrance to the office is where the end spaces have been darkened. Ideally, these dark end spaces can be used for quiet private offices or non-public areas.



"T" shaped spaces.

To make the "T" shaped space workable, draw an imaginery square as shown. The resulting square footage should be used as the "public area." The darkened space at the bottom should be used for quiet private areas and/or non-public. Ideally, the best entrance for the configuration would be in the corner along the top of the "T".



Ratio

When choosing space, try to avoid long rectangles. The best suggestion is to try to find a space whose ratio is 2:1, length to width.

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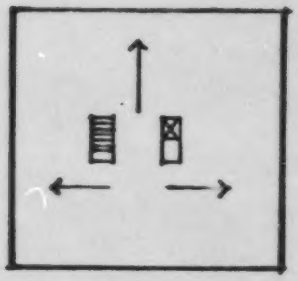
suggests that one gets more useable space per square foot. Also, as far as human behavior is concerned, a square is easier to defend and mark out territories than say, an irregular shape. But most of all, a square is simply the easiest upon which to add or detract -- and is the best space configuration with which to work for long range planning.

Of course, it is not easy to find office spaces that are more or less square. Other corporations may have space in the same facility, causing the offices offered to be irregular (or even, in different parts of the building). Or the building may be an odd shape for aesthetic and/or site considerations. Indeed, most office buildings tend to be rectangular. There are large office complexes that are 100' x 200' or more -- the size of a city block (which leads us to another question, how large should the space be on one floor before one goes to two floors? Many companies do not like to have more than 10,000 sq. ft., 1/2 city block on one floor -- the walking is too much for the employees...but that is up to the type of the company. If there is little inter-departmental or inter-division communication then it doesn't matter).

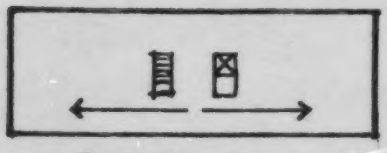
But we strongly suggest whenever possible to choose office spaces that most nearly approach a square. The next three most common spaces besides a rectangle (and a long rectangle at that) are the U, L and T configurations. Any arrangement which tends to spread out the floor areas causes the company to pay for more wall and corridor space per square foot than useable floor area.

In working out any space arrangement the first thing that is necessary is to locate the service areas: the elevators, entrances, exits, stairs, and perhaps even the toilets. These are the major personnel and visitor traffic areas, the points

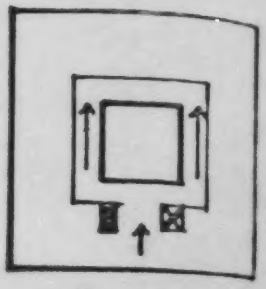
SHAPE AND MOVEMENT



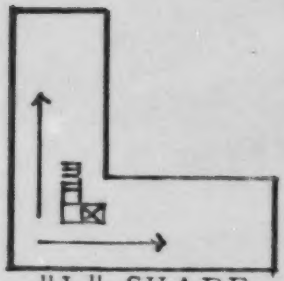
Square



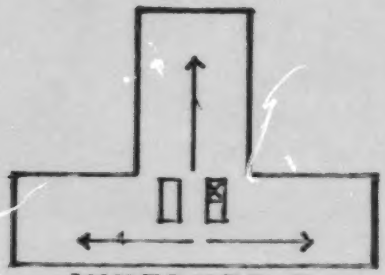
Rectangle



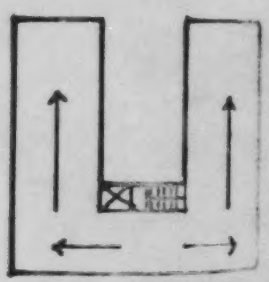
Donut



"L" SHAPE



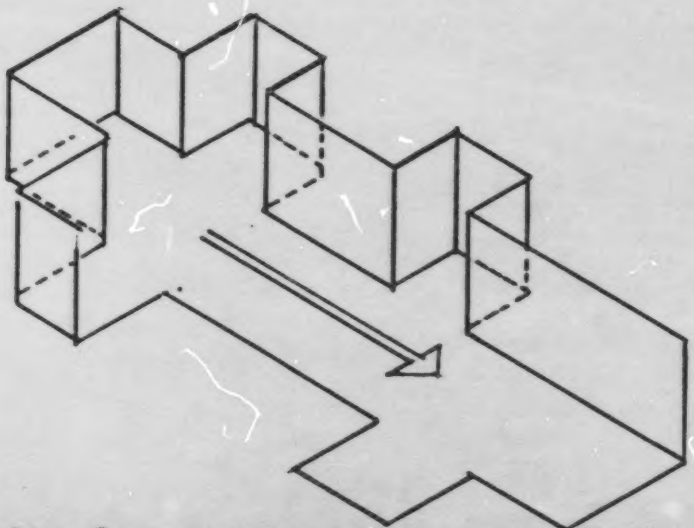
INVERTED T



"U" SHAPE

1. Quality of shape is most important - shapes that approach a square are best.

2. Factors that determine movement of people in space are:
   a. Shape
      (for example, "U" shape is less efficient than a square)
   b. Location of entrances/exits, stairs, elev
   c. Ceiling heights (low ceilings are restrict



Simple movement in a complex shape

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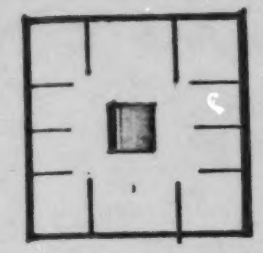
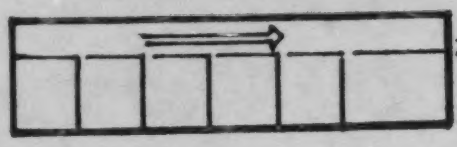
SHAPE OF ROOM

Use and Function



Square

vs.

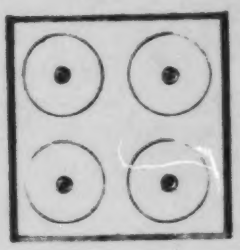


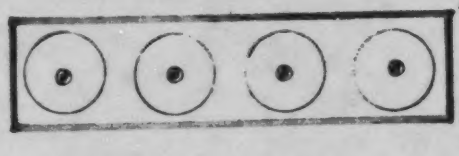
Rectangle

Square

1. Efficiency, less movement, distance to travel
2. Less corridor space
3. Ease of arrangement of furniture

Illumination

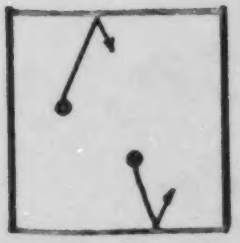




Square

1. Greater illumination with less light
2. Greater overlapping of light

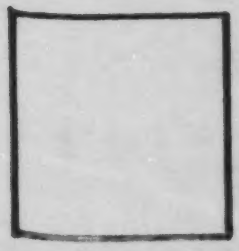
Acoustics



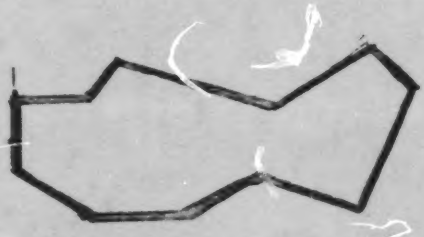
Square

Because walls are farther apart, less reflection of sound from walls, . . . less echo

Behavior



Square



Irregular

Square

Square is easier to defend than long rectangular space or irregular shape

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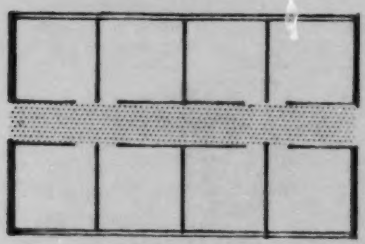
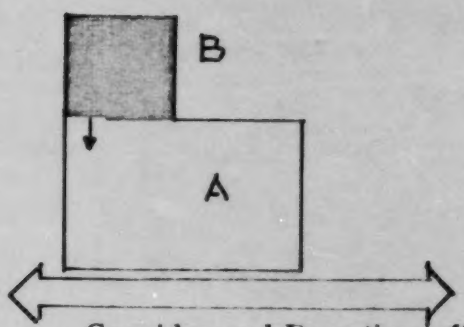
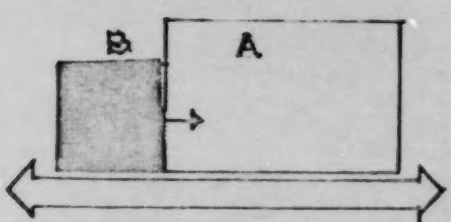
Single Loaded Corridor



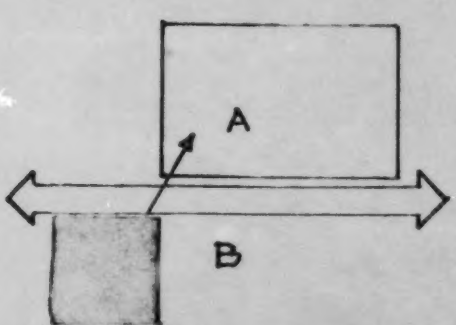
Double Loaded Corridor



Corridor and Pass thru offices



Corridor and Side by Side Offices



Corridor and By-pass Offices

PROXIMITY RELATIONSHIPS

Single Loaded Corridor:
Less contact with other workers....
.except for immediate neighbors, far away from other workers.
.little or no visual contact or control.
.good for situations where employees work independently.

Double Loaded Corridor:
More contact with other workers...with close proximity to five other workers.
.more visual contact or control.
.better use of space than single loaded corridor.
.can be used for situations where employees work independently or together.

ADJACENCIES

Corridor and Pass Thru Offices most common situation where employees in "A" protect employee in "B"....the so-called management office.
."A" and "B" must have like functions.
."A" has problem of noise, visual contact and even access for "B".

Corridor and Side by Side offices are less common situation where "B" is the managerial office for "A". A good situation
."A" and "B" can work together or independently.
."B" may be a department that must work closely with the larger "A"....there is an ease of communication between the two.
.Both have good access and visual contact
.Either can be expanded or contracted.

Corridor and By-pass Offices is the least common situation where "B" is the manager's office for "A". A poor situation for
.there is poor access and visual contact or control between "A" and "B".
.this would be a better situation if both departments did not relate closely at all.

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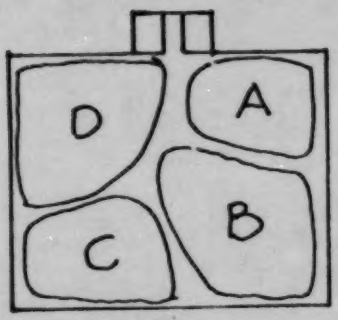
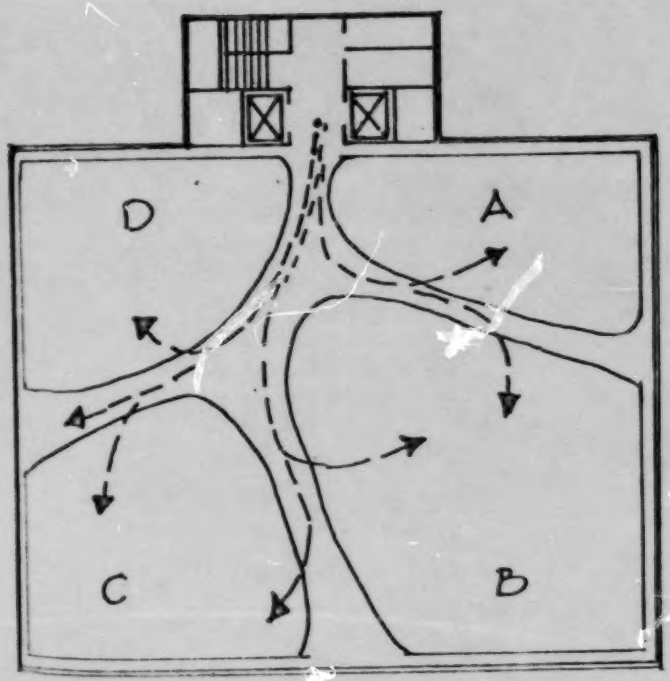
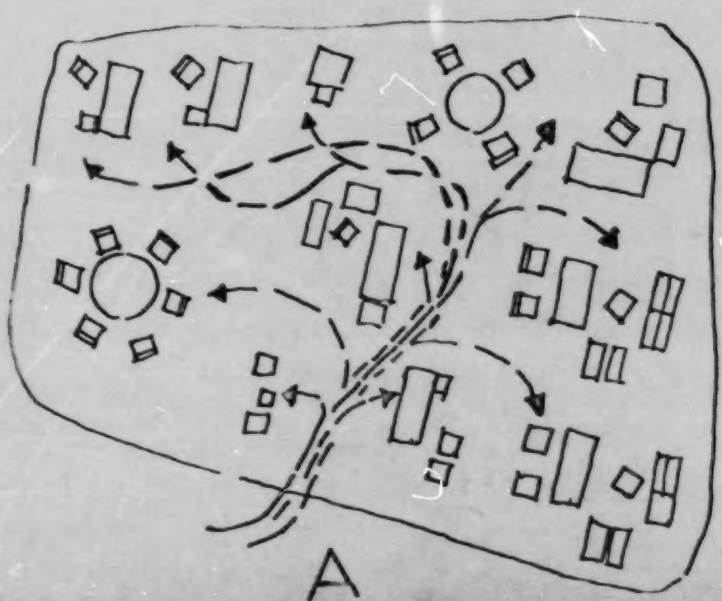
BUBBLE DIAGRAMS



- Each bubble indicates different functions or departments. For example:
  Bubble A may be Sales
  Bubble B may be Administration
  Bubble C may be Accounting
  Bubble D may be stock room and mail room.
- Each bubble shows adjacencies that are essential:
  "D" and "A" must be close to reception
  "C" and "A" don't work closely together, etc.



Typical bubble diagram showing interoffice and visitor traffic patterns



Typical diagram showing furniture arrangement and traffic pattern within one department. . . . in this case "Department A".

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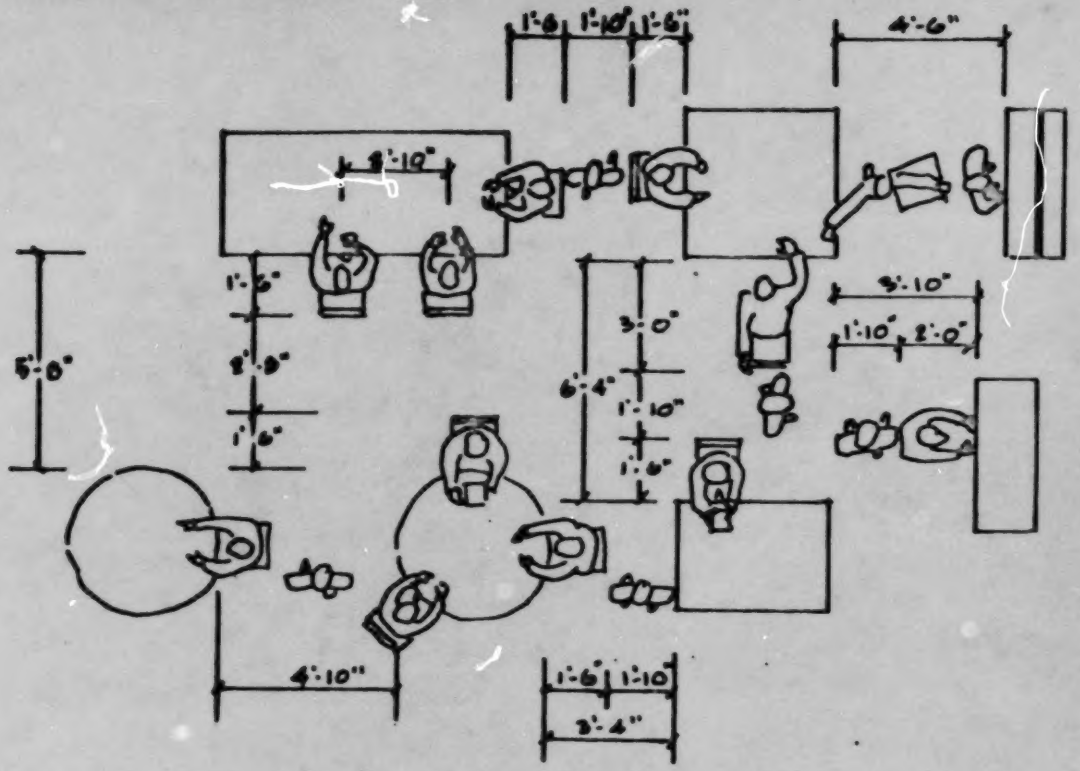
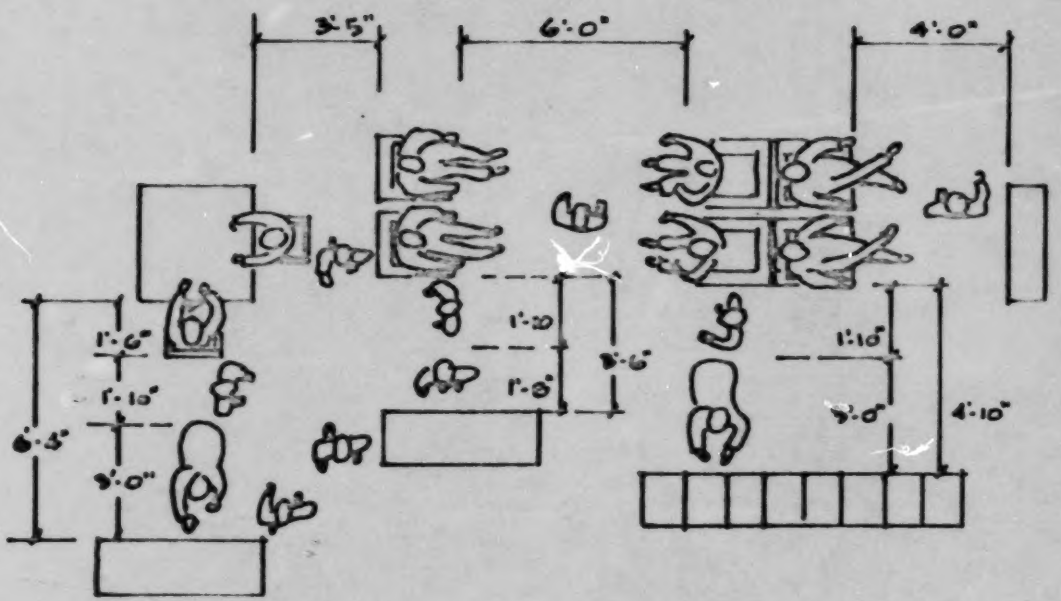


Minimum clearances between tables and club chairs



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must be worked out that provide a general description of the priorities and personnel relationships relevant to the work flow:

1. How many people work in the department? How many will be working in the department in the future? (Is expansion or contraction slated for the near future?)
2. How do the staff members in this department work together -- in constant close communication, or with little intra-departmental communication?
3. What tasks are performed? Will tasks be added or deleted in the future?
4. Is special equipment required? Does the special equipment require special installation? (Check electrical wiring, computer access, floor loading, communications equipment)
5. Are special facilities required? (Check soundproofing, special lighting, additional square foot areas, etc.)
6. Is privacy important (individual offices, etc.)
7. Are there many interdepartmental contacts? Must they be located close to any other specific departments?
8. Will there be a need for shared facilities between departments?
9. Is there any special communication and/or information needs relevant to people or paper traffic?
10. Is there outside communication with the public? What kind and how often?

Next a general description of each work station and/or office must be detailed -- the size of the average working surface, filing, storage, display, communication equipment and seating arrangements to receive the average square footage.

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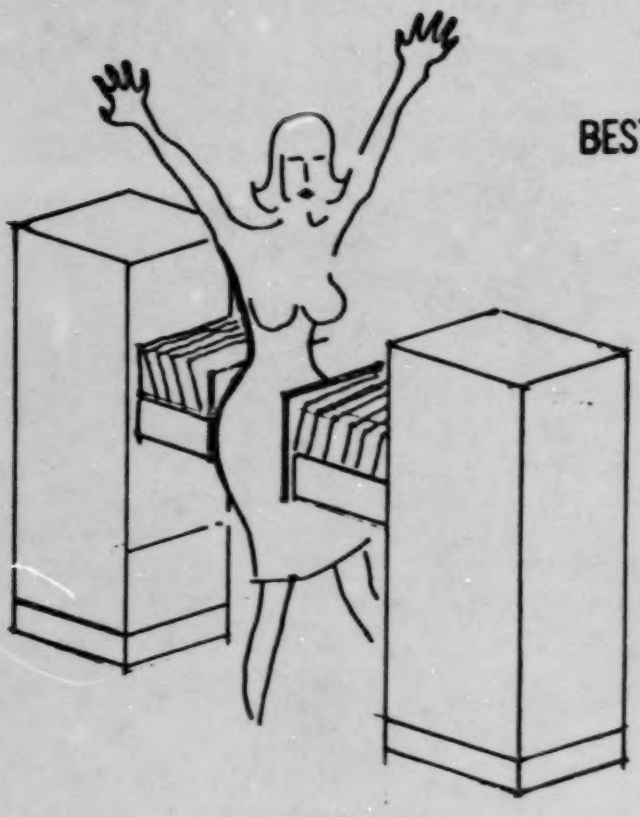
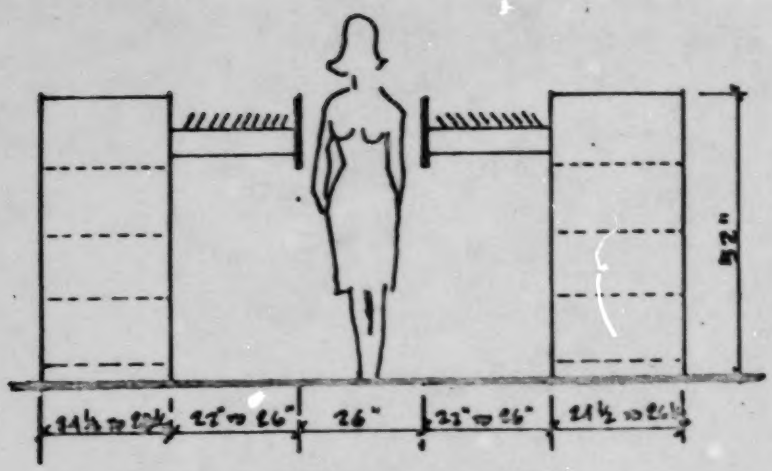
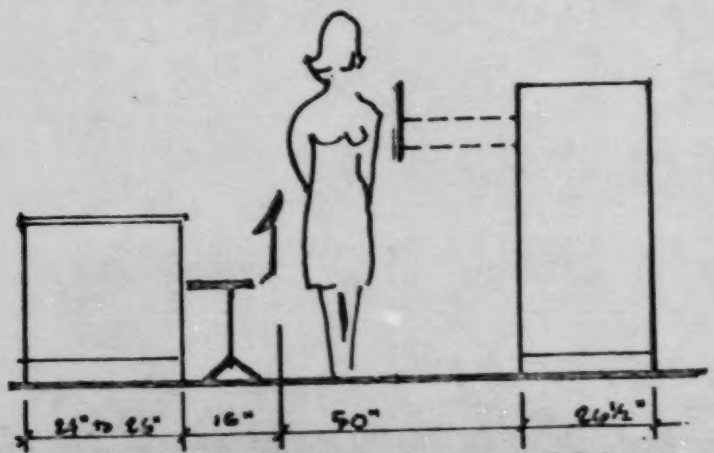




Open files and pass



Desk plus passage

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At this point the data gathering can turn into a proposed design. If in-house design staff or an architect and/or interior designer has been working on the project he/she should not only be able to tell how much space is actually required, but approximately how much it will cost in furniture and equipment. At this time also, the design "concept" can be proposed.

It is the design concept which is the creative aspect of the work....making the space look good. The design concept should create a balance between the work functions the behavioral aspects of space, and the aesthetics. Most often the behavioral aspects and the aesthetics are confused, if for no other reason than designers are more interested in the visual or the "look" of the space. Here, one should use common sense. If a proposed design does not "feel" right, most likely it is not right.

The designer should present floor plans and layouts which show the furnishings in place. Especially in the larger loft type office buildings, it is the furnishings rather than the walls which enclose space. A lighting plan should also be drawn, showing where the lights fall in relation to the work areas. (These plans are in addition to the construction documents in the case of new building or major renovation or addition).

Of course, one might well ask, why go to all this trouble if all we need is just a little more space. Obviously, one does not have to go to all this trouble if the amount of area needed is minimal. However, if the office is considering a major move, then we suggest that not only is all of this work important, but some of it should be done even before new space is actually sought. It is important to have some definite idea of exactly how much space is needed. If the estimate is badly off then the whole move may be only an exercise in futility.... and a waste of

company money.

Finally, some points not stressed in the material above:

Beware of non-assignable space. Non-assignable space includes such things as corridors, walkways, entrances, exits and the like. When estimating square footage, be certain to leave an allowance for walkways so that an employee can get from one place to another. This is one area that causes under-estimated square footage, and problems of too tight space. Non-assignable square footage should be between 10-20% of the overall allocation. If the non-assignable square footage comes out to 25% or more, than the office should be re-designed. There's a lot of waste space.

Zoning may be a problem. The zoning laws of the city in question must be checked out, either by knowledgeable in-house staff, or by an architect, interior designer or engineer. Most cities have Building Departments where this material can be obtained. For one reason or another an office building may not be suitable for a company's proposed purposes.

Floor loading may be a serious consideration. Especially for a company with a large Records Storage Center or an extensive Central Computer area, heavy weights may be a problem with which to contend. A structural engineer must be consulted and called in on the job. If an architect has been retained and there is any question, more than likely he/she will question a structural engineer. However, an interior designer may not--some of the smaller interior design houses do not work with engineers in their work and may not be aware of special floor loading situations.

And lastly, in leased office space, at times the landlord will supply the architect and/or engineers necessary. But because the purpose to which the space

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will be put is not the landlord's, specific and important areas may be missed. Special staff, an outside consultant, or someone knowlegeable should be put on the job to act as liason between the company and the landlord's construction team to make sure the job turns out right.

B2 Interpretation, Research & Information — 02 Study Room / Period Room Reading Room (Chapel)

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10 GENERAL REQUIREMENTS

Access	open	
	controlled	(2)
	restricted	
Art content	art display	(3)
	art storage	
	no	
Utilization	office hours	
	gallery hours	●
	special	
Security	normal	
	intensive	
	special	●

20 HANDICAPPED REQUIREMENTS

Accessible and useable	yes	●
	no	
	special	

30 USER REQUIREMENTS

User needs	staff
	visitors
	others

40 FUNCTIONAL REQUIREMENTS

Occupant load	staff	4 (4)
	visitors	60
	special	
Works of art		(3)
Furnishings	display furniture	
	work stations	
	equipment	
	built-ins	
	special	(5)
Activities	gallery	
	interpretation	●
	custodial	
	administration	
	support	
	site	
Other		

50 AREA REQUIREMENTS

Floor area	4,285	n.s.f.

60 LOCATIONAL REQUIREMENTS

Between spaces		
Adjacent to	B2-01	
Accessible from circulation	yes	
	optional	
	no	●
Special		

70 SPATIAL REQUIREMENTS (14)

Internal flexibility	important	(9)
	normal	
	not required	
Proportions	square	
	rectangular	
	special	(1)
Daylight	yes	(7)
	optional	
	no	
View outside	yes	
	optional	
	no	(8)
Ceiling height	maximum	
	preferred	
	minimum	
	special	(12)
Access/ egress	normal	
	gallery	
	special	(10)
Surfaces	normal	
	gallery	
	special	(13)
Other		

80 PERFORMANCE REQUIREMENTS

Temperature	72° F/hr	●
	70° F/hr	
	special	
Humidity	30% W/50° S	●
	47% W/53° S	
	special	
Ventilation	air changes/hr	
	% outdoor air	
	filtration	
Controls	thermostat	
	humidistat	
	special	
Lighting (6)	general f c	
	task f c	
	variable f c	●
	controlled freq	
	incandescent	●
	fluorescent	
	special	
Acoustics	STC	
	SAC	
	IIC	
Finishes	FSR	
	SDR	
	fire rating	
Structure	normal	
	gallery	
	special	(11)

90 SPECIFICATION REQUIREMENTS

Electricity	outlets	●
	special voltage	
	emergency	
	other	
Communications	telephone	
	intercom	
	security	
	CCTV	
	P.A. system	
	A/V outlets	
Plumbing	water supply	
	floor drain	
	fixtures	
	sink	
	other	

NOTES

(1) 98½" long x 43½" wide. Exact dimensions of wooden units to be assembled to be checked by architect.

(2) Visitors will sign register.

(3) Works of art may be placed in this space at the Director's discretion.

(4) 4 librarians or clerks in rotation.

(5) 12 large work tables, bookcases for reference books, shelves for periodicals.

(6) Lighting should be adequate for reading and be compatible with aesthetic requirements of chapel architecture.

(7) Through windows that are already in the collection.

(8) Windows in collection are stained-glass.

(9) The structure of the chapel is fixed, but flexibility within it is possible and desirable.

(10) Double doors required at entrance, and at entrance to reference book area. It must be possible move vaults of chapel (15' high, 12' square) into space for installation as an integral part of the interior design of the building.

(11) Floors should be adequate to load imposed by bookshelves, bookcases, display cases, etc.

(12) Ceiling of chapel is 26' high.

(13) Surfaces should simulate those of the original chapel.

(14) Interior panelled walls and vaulted ceiling of the chapel of the Convent of Notre-Dame du Sacré-Coeur, 1887-1888, were purchased by the NGC in 1973 and are in storage in preparation for installation as the interior to this room.

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Note the activity-area, sub-area or individual given above. Use the vowel-letter ratings below to rate the degree of closeness desired between this activity-area and the others listed at the bottom of this page. Ratings should represent closeness desired in an ideal situation. For each rating other than U (Unimportant) give one or more reasons using the code numbers below. Most ratings should be U's and O's. There should be very few E's and perhaps only one or even no A's. Make ratings for the period above.

CLOSENESS DESIRED RATINGS	REASONS FOR CLOSENESS
A – Absolutely Necessary	1. Flow of material/paperwork
E – Especially Important	2. Personal contact required
I – Important	3. Ease of supervision
O – Ordinary Closeness OK	4. Use same records
U – Unimportant	5. Use same personnel
X – Not Desirable	6. Use same equipment
	7. Use same utilities
	8. Reception of visitors
	9. Visitor convenience
	10. Employee convenience
	11. Light, natural conditions
	12. Noise, hazard, dirt
	13.
	14.

NO.	ACTIVITY-AREA	Rating (Letter)	Reason (Number)

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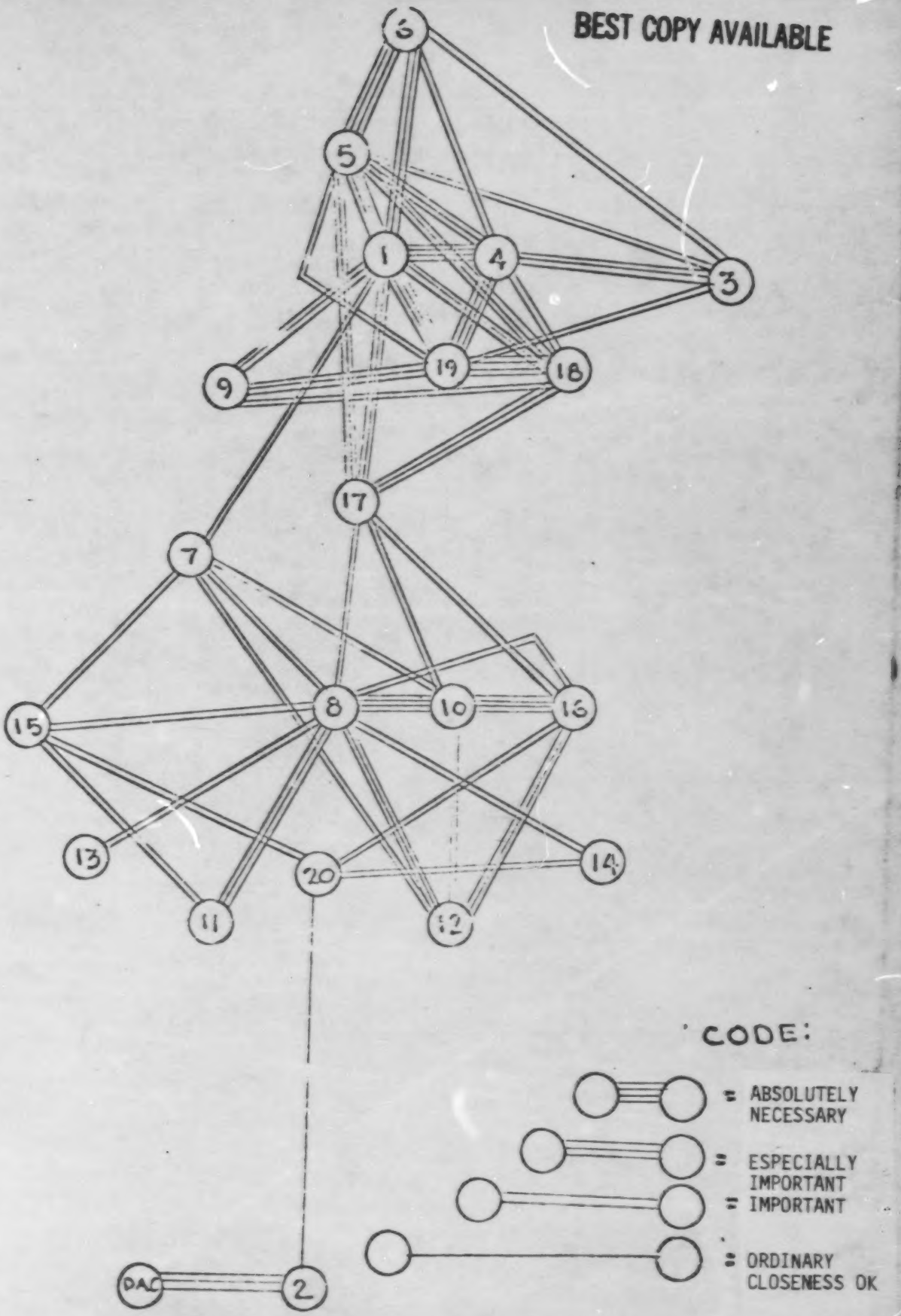


STEP 1: CHART THE RELATIONSHIPS

Your first step is to relate each activity, area, function, or major building space involved in the contemplated layout to every other activity by a closeness-desired rating. This is a rating step to determine the relative closeness between each pair of activities or areas.

WHAT YOU DO

Identify each activity involved and list all activities on a relationship chart.

Examine and record a closeness-desired rating for each activity relative to every other activity.

Record the reason, or reasons, for assigning each closeness rating determined.

WHY YOU DO IT

You cannot make a layout without making decisions as to how close various activities should be to one another. A relationship chart is a simple and effective device to help organize these decisions into a useable form.

On the example on the facing page, there are 63 separate decisions as to how one activity relates to another.

The relationship chart relieves you of the problem of keeping in mind all these decisions and the reasons for them. This becomes more important if you have more activities, as in the second example on the following pages where 19 activities require 171 decisions.

Also, by recording both the closeness-ratings and the supporting reasons, you ensure consistency in your relationships and the ability to substantiate and check back on what you have done.

The relationship chart serves as a convenient check sheet that keeps you from overlooking any relationship that should be included in your planning.

HOW YOU DO IT

1. Complete the heading on the form at right to identify the layout. (These data should be entered on every paper used in planning a layout.)

2. Identify each activity involved, and list them on the relationship chart. If there are more than 20 activities, check and consolidate as appropriate.

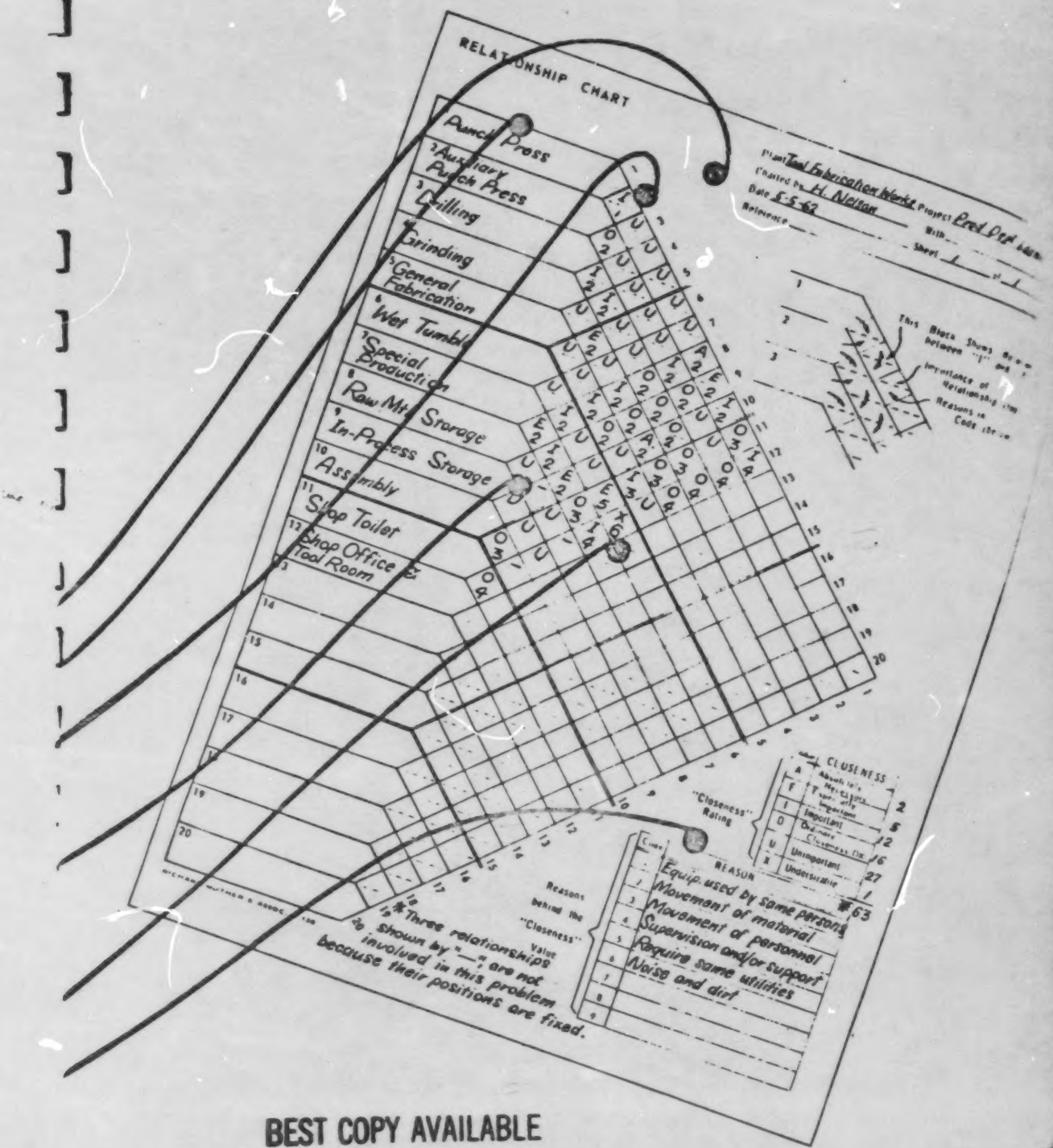
3. Determine and record in the upper half of the appropriate diamond-shaped block a closeness rating for each activity relative to every other activity. For example: Punch Press (Activity 1) relates to Grinding (Activity 4) in the block where down-sloping line 1 intersects up-sloping line 4. In turn, Grinding relates to Shop Office and Tool Room where down-sloping line 4 interesects up-sloping line 12.

Use the vowel letters (A, E, I, O, and U) to show the degree of closeness desired. Use X to show that closeness is undesirable. Use a dash line when certain existing activites are already fixed; or when the relationship between them is not involved in the problem.

The use of vowel letters for coding in rating closeness is wise for several reasons. The letters themselves have a meaning (in English). A is for Absolutely necessary; E for Especially important; I for Important: O for Ordinary closeness; and U for Unimportant. Second, the vowels are easy to remember. Third, you avoid using numbers because they tend to imply an accuracy greater than the actual rating, and they would be confused with activity numbers and reason-code numbers.

4. Record a reason-code number in the lower half of each block in which a rating other than U is recorded.

5. Explain each reason code used with an appropriate entry in the reason box on the form.



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For a more complex example of Step 1, turn the page

...STEP 2: ESTABLISH SPACE REQUIREMENTS

Establish for each activity the required area, the physical features and utilities, and any restrictions in configuration.

WHAT YOU DO

Use the same list of activities (or subactivities or areas) as in Step 1.

Determine and record the space for each listed activity.

Establish and record any specific structural or physical-feature requirements for each activity.

List any requirements for utilities and/or special equipment.

Show any requirements that affect or restrict the shape or configuration of an activity's space.

WHY YOU DO IT

Activity-closeness, or adjacency, is meaningless until space requirements are tied in. Therefore, you must develop space requirements for each activity.

In addition to the *amount* of space or area, you need the *kind* of space. To get it, you must know what physical features each activity will require. This way you can [illegible]ate your planning with the practical considerations involved in construction. And you need a check on the utilities or special services of each activity.

Additionally, you need to know if there is a mandatory requirement for the space supporting a given activity to conform to a specific *configuration*. This will help give shape to each activity's space and reduce later work when you adjust the layout.

HOW YOU DO IT

1. List each activity on the activity area and features sheet at right. Use the same sequence and terminology as in the listings on the relationship chart.

2. Enter the area (usually in square feet) required to support each activity listed.

3. Determine the requirements, in unit of measure and amount, for specific physical features such as floor loading and ceiling height. Enter these on the sheet.

4. Determine the importance of providing specific utilities and/or special supporting services. Show by entering the appropriate vowel-letter rating (as explained in t... column heading) in the proper block.

5. Show any requirement for a specific shape or configuration of space. List the reason or reasons that support each requirement.

6. Enter any additional explanatory or qualifying comments at the bottom of the sheet. Reference these comments by placing the appropriate encircled lower-case letter in the proper place on the form.

Note that in this tool fabrication works example there is no space requirement for activities 8, 10, and 12. The layout of the areas supporting these activities is not part of this problem and their locations are already fixed. Therefore, there is "no relationship" between these areas, although each must relate to the other activities that are being laid out.

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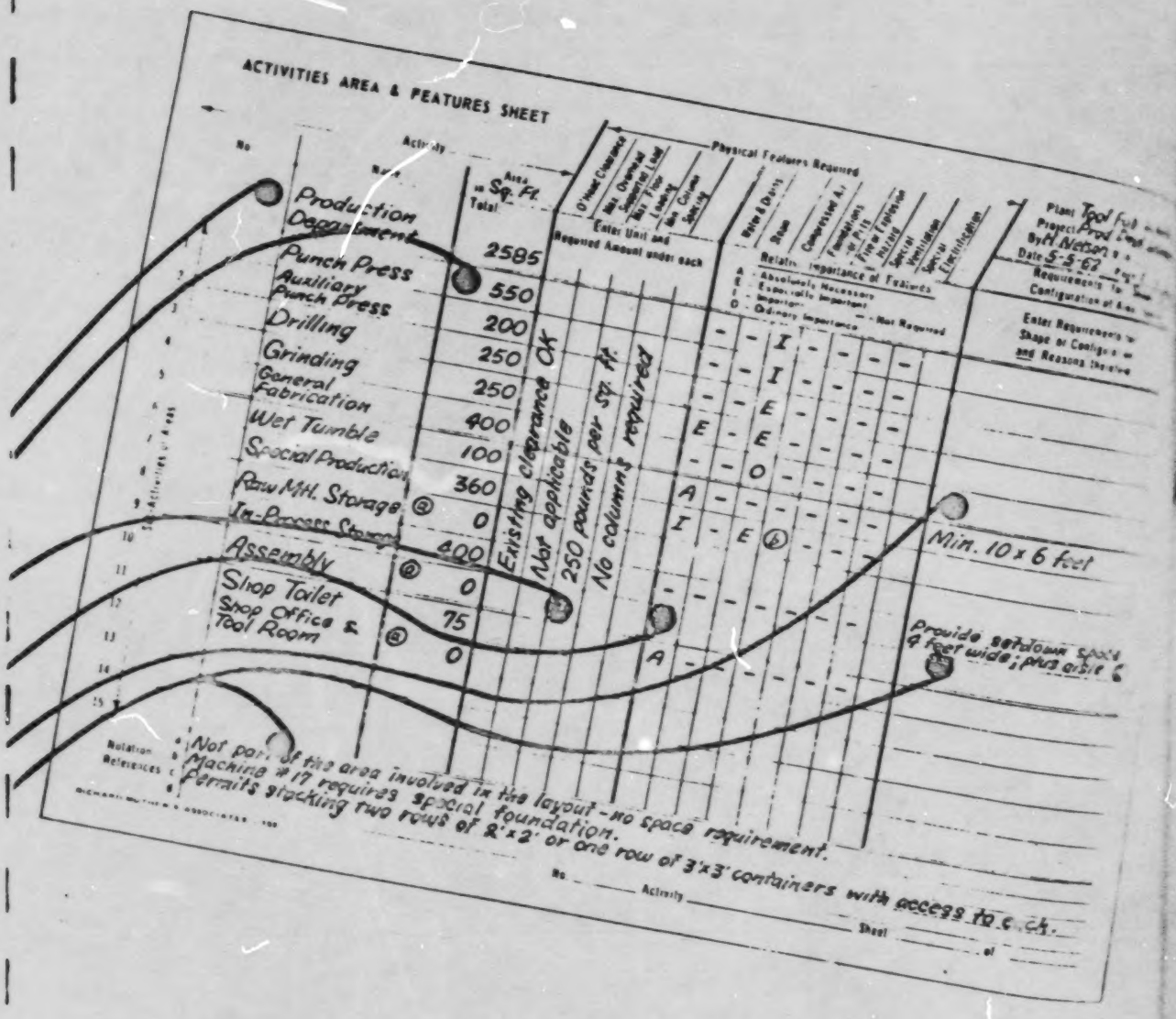

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For a more complex
of Step 2, turn

...STEP 3: DIAGRAM ACTIVITY RELATIONSHIPS

In this step you relate the various activities to each other visually and geographically to form the basic pattern for your layout.

WHAT YOU DO

Use a symbol to represent an activity.

Use a line code to show closeness-rating.

Work out on paper the arrangement of activities that places those with higher closeness-ratings nearest each other, and those with lower closeness ratings progressively further away.

WHY YOU DO IT

You want your facility to conform as nearly as possible to the ideal arrangement. The relationship diagram will help you work toward such an arrangement by converting your relationship chart of closeness-ratings into diagramatic form.

What you actually do in this step is draw, in physical arrangement, the relationships desired and previously recorded on the chart. You are diagraming the best fit of the many relationships rated.

Since the relationship diagram forms the basis for all the following steps it is essential that you work carefully to arrive at the best possible arrangement. Any errors or oversights in this step are likely to carry on through into the final layout.

HOW YOU DO IT

1. Use the corresponding activity, line, or number (enclose in a circle) from the relationship chart to represent each activity when diagraming.

2. Diagram on a sheet of paper each pair of activities having an A-rated relationship. Then connect them by *four* parallel lines.

3. Redraw for the best arrangement of A-rated activities if needed.

4. Add E-rated relationships, including any new activities involved—connect by *three* parallel lines.

5. Rearrange as required and add I-rated relationships—connect by *two* parallel lines.

6. Rearrange, if needed, and add O-rated relationships (connect by *one* line) and X-rated relationships (connect by a *wiggly* line).

7. Rearrange final activity relationship diagram for best fit of all activities.

8. Mark on the diagram, beside each activity's designation, required floor space established in Step 2.

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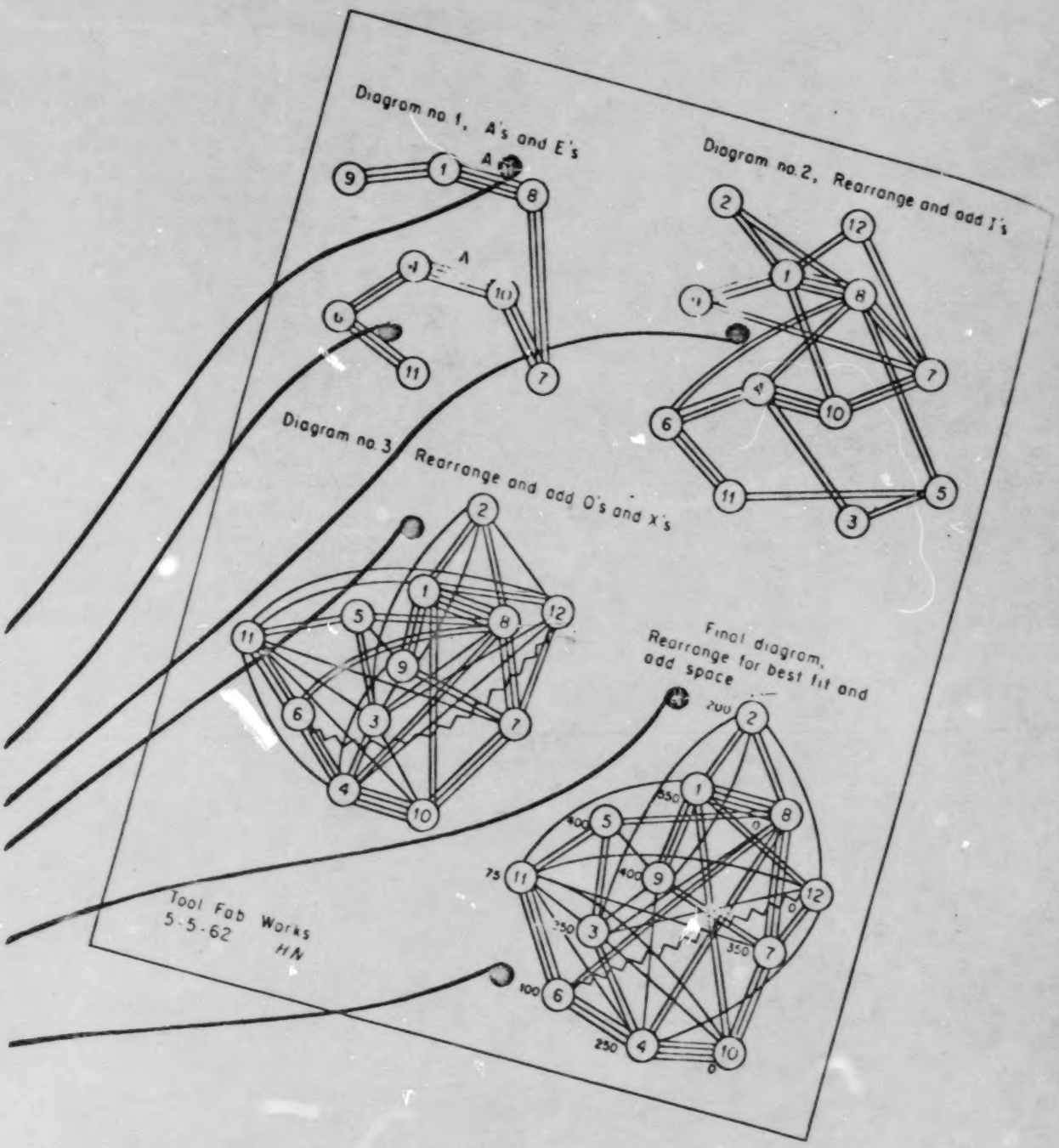
Diagram no 1, A's and E's
Diagram no 2, Rearrange and add I's
Diagram no 3, Rearrange and add O's and X's
Final diagram, Rearrange for best fit and add space
Tool Fab Works
5-5-62
HN

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For a more complex ...
of Step 3, turn ...

STEP 4: DRAW SPACE RELATIONSHIP LAYOUTS

This is how you visually and geographically arrange the space required for all activities. You make any adjustments or rearrangements necessary to integrate all modifying considerations.

WHAT YOU DO

Establish a workable scale, preferably one that will permit showing the whole plan on one sheet.

Draw the outline of the space required for each activity, following the diagram for Step 3.

Adjust and rearrange to integrate modifying considerations and physical features.

Draw or sketch all likely solutions.

WHY YOU DO IT

No matter how well you arrange the individual details of your layout, you cannot get maximum operating effectiveness from the facility if your over-all space relationship layout is made improperly.

You should develop the "ideal" space arrangement first. Then work to a realistic arrangement, with a minimum departure from the ideal, before proceeding with the placement of details.

Step 3 helped you to visualize relationships. But these diagrams are not meaningful until converted to blocks of space of the proper area or size.

You must do Step 4 to get specific dimensions and to allow you to check such physical features as columns, access ways, minimum exterior walls, fit on site, and the like.

Usually there are several workable arrangements of space. Three or four alternative arrangements will generally be sufficient to decide on the best layout.

HOW YOU DO IT

1. Use cross-section paper--preferably with 1/4-in. grid and on tracing paper. (Normally a "fade-out" grid that will not reproduce is best.)

2. Select a scale so that the entire facility fits on one sheet of paper conveniently.

3. Mark-off on the grid the equivalent space for each activity on the relationship diagram made in Step 3.

4. If planning for new construction, make adjustments in the area configuration so that you have reasonably straight exterior walls of the minimum practical length.

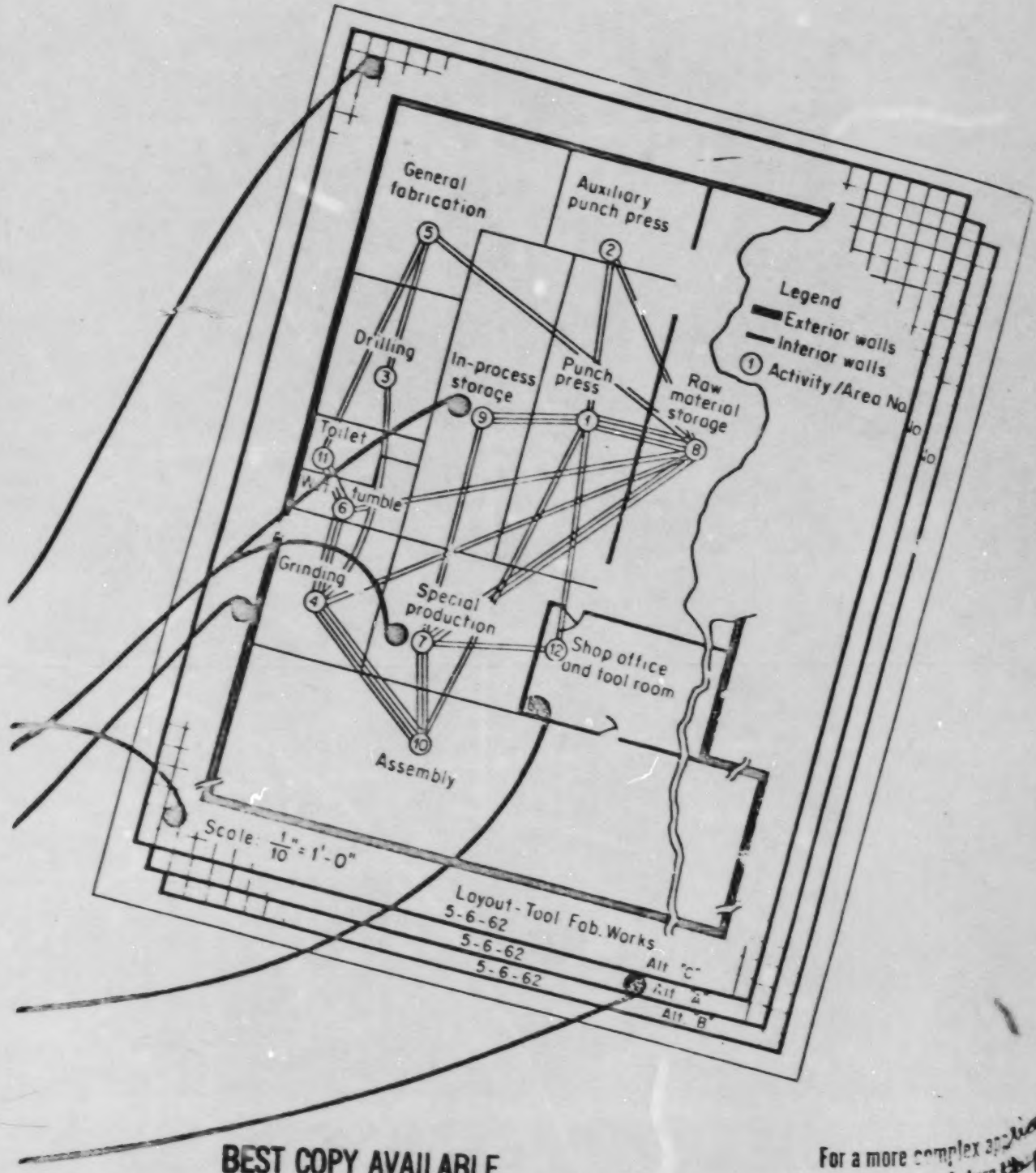
5. If planning a rearrangement or an expansion, draw or obtain an outline of the existing floor space or building. Place your block-area layout over this building outline, and adjust your layout to best fit the existing structure.

6. Show such physical features as columns, walls, major access doors, and the like.

7. For an existing building, add any permanent features such as interior load-bearing walls, toilets, and major utility service points.

8. Check your layout for best orientation with surrounding features such as streets, rail access, and utility lines, and for best use of the total area. In this example, this "site" orientation was already fixed.

9. Repeat Points 3 through 8 above, for all various alternative arrangements that seem to be logical workable layouts. Three alternative arrangements were sufficient for the tool fabrication works.



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For a more complex application of Step 4, turn this page

...STEP 5: EVALUATE ALTERNATIVE ARRANGEMENTS

Here you select the space arrangement or over-all layout most suitable for your company. To do this you make an evaluation of the alternative arrangements developed in Step 4.

WHAT YOU DO

Identify each alternative arrangement.

Establish all pertinent factors, considerations, or objectives affecting the choice of the best alternative.

Assign to each factor a weight value indicating its relative importance to the layout's effectiveness.

Rate each alternative plan for each of the factors —using the same vowel-letter rating as before.

Convert all letter ratings to numbers and multiply by the previously established weights.

Total the weighted rate values for each alternative arrangement. The highest total should indicate the best available alternative.

WHY YOU DO IT

Only by making an evaluation as objectively and impartially as possible can you come up with the best decision.

A listing of advantages and disadvantages, or pros and cons, usually does not dig deep enough and does not give adequate recognition to the relative importance of various factors.

At the other extreme, an accurate and detailed comparison of cost figures often results in a stand-off.

This evaluation procedure can prevent your overlooking an important factor. Besides, it allows you to get more people into the act and lets them participate in the decision.

HOW YOU DO IT

1. Identify each alternative plan by letter—A, B, C, and so on. Give each a brief three-to-five-word description, and enter on an Evaluating Alternatives form.

2. Establish all factors, considerations, or objectives the company wants the layout to achieve. List these on the form, using care in the wording so the factors are clearly defined.

3. Select the most important factor and assign to it a weight of 10. Weigh the importance to the facilities of each other factor relative to the most important (10); indicate its weight on the form; and record by whom the weight values were determined.

4. Rate for each factor the effectiveness of each alternative arrangement in achieving that factor's objective using A, E, I, O, and U to represent a descending order of effectiveness. Enter on the form the selected letter ratings and the name(s) of the person(s) making the ratings.

5. After rating each alternative for all factors, convert letters to numbers (A=4, E=3, I=2, O=1, U=0;) and multiply by the respective weight values. Enter the resulting weighted rate values on the form.

6. Total the weighted rate values for each alternative arrangement, enter on the form, and record by whom the tally was made.

7. The plan with the highest total should be the best alternative layout.

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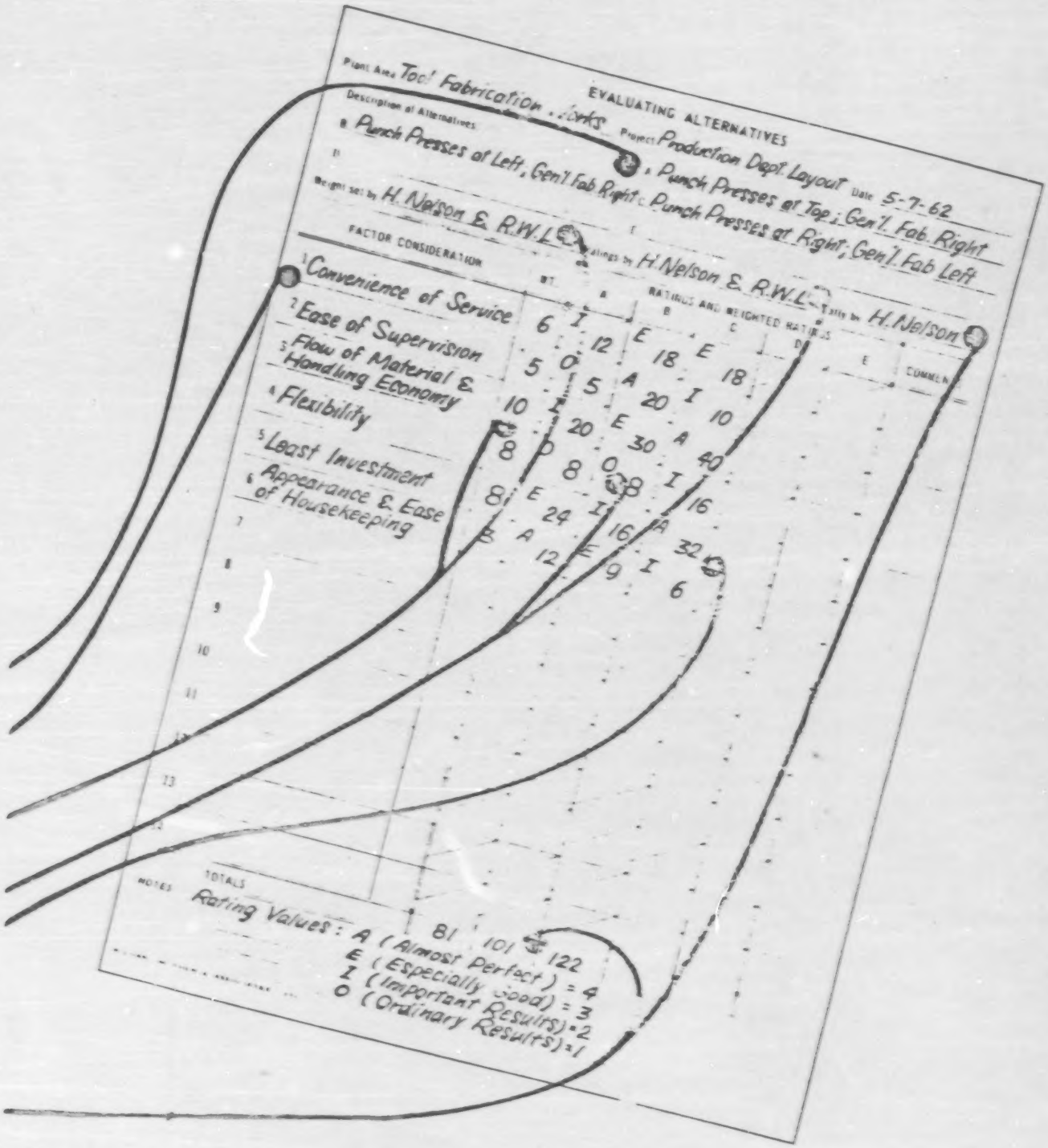

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For a more complex application of Step 5, turn the page

5

APPLICATION IN AN OFFICE

EVALUATING ALTERNATIVES

Plant/Area STERLING INSURANCE CO. DISTRICT # 2 OFFICE Project OFFICE LAYOUT Date 3-10

Description of Alternatives:
A. CLUSTER ~ CENTRALIZED SERVICES
B. CLUSTER ~ PERIPHERAL SERVICES
C. U-SHAPED LAYOUT WITH CENTRAL RECEPTION ROOM
D. FRONT RECEPTION - SERVICES IN REAR
E.

Weight set by J.R.T. Ratings by L.S. & B.G. Tally by B.G

	FACTOR/CONSIDERATION	WT.	RATINGS AND WEIGHTED RATINGS A	B	C	D	E	COMMENTS
1	FLEXIBILITY AND EASE OF EXPANSION	8	E 24	O 8	I 16	E 24		
2	ADAPTABILITY AND VERSATILITY	4	A 16	A- 14	I 8	E 12		
3	EFFECTIVENESS OF MOVEMENT	8	E 24	E 24	I 16	I 16		
4	EFFECTIVENESS OF SPACE UTILIZATION	5	E- 13	E 15	O 5	O 5		
5	TIE-IN OF SUPPORTING SERVICE	6	I 12	I 2	E 18	I 12		
6	EASE OF CONTROL AND SUPERVISION	10	O 10	E 30	I- 15	I 20		
7	APPEARANCE	3	I 6	E 9	A 12	E 9		
8	USE OF NATURAL CONDITIONS	2	A 8	I 4	E 6	O 2		
9	FIT WITH COMPANY ORGANIZATION STRUCTURE	5	E 15	I 10	I 10	I 10		
10	BEST PLAN FOR MONEY INVESTED	8	A 32	E 24	I 16	E- 20		
11								
12								
13								
14								
	TOTALS		160	150	122	130		

NOTES A = ALMOST PERFECT (4), E = ESPECIALLY GOOD (3),
I = IMPORTANT RESULTS OBTAINED (2), O = OK, ORDINARY RESULTS OBTAINED (1),
U = UNIMPORTANT RESULTS (0)

RICHARD MUTHER & ASSOCIATES - 171

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BACKGROUND

The evaluation of alternative layouts (on left) was made for a rearrangement of the District Two Office of the Sterling Insurance Company. This is a small company that needed to improve its office layout. Four alternatives were assessed for effectiveness.

ANALYSIS

The 10 factors chosen for consideration are typical of office layout projects. However, the weights vary from project to project depending on both the situation and the persons involved.

Note that in rating Alternative B for Factor 2, a rating of "A-" was used. The minus sign gives more preciseness to the rating values. "Minus" indicates a numerical value half-way between the letter used and the next lower letter on the scale of values.

The point total for Plan A (160) is not enough greater than that for Plan B (150) to substantiate a clear-cut decision. Certainly either would be more effective than Plans C or D (122 or 130).

PRACTICAL APPLICATION POINTS

When two plans rate nearly the same in total points, there are several things you can do. First, you can re-evaluate with more, or more precise factors. Second, you can re-evaluate by inviting other people to participate in the ratings —with the additional advantage of making them feel they have a personal part in a decision that affects them and their jobs. Third, you can take another look at the two or three best plans and see where they rated the lowest — the Os and Us. There may be some way in which those weaknesses can be strengthened or improved.

It is better to rate all plans for a given factor rather than to rate one plan at a time for all factors. In other words, work across the form from side to side rather than from top to bottom in each column. By doing this you can be sure to keep the same meaning for a given factor as you move from plan to plan. It will also prevent a biased rating that could result from a person tending to favor a given plan for one reason or another.

Ratings may be done by one person, or by several persons. If more than one person is involved, it is better to have each make his own ratings independent of the others. Then they can get together to compare the results and resolve any differences.

SUMMARY

Here in Step 5 you have brought your best judgment to bear in a comparison of the alternative plans. You did this by determining the factors and considerations bearing on the effectiveness of the facility, by determining the relative weight of each of these factors, and then by rating each alternative plan for each factor.

You then converted those ratings to numerical values, totaled the values, and compared the totals. By selecting the plan with the highest total, you know your choice is based on a careful and reasonably unbiased analysis.

WHAT STEPS 1 THROUGH 5 ACCOMPLISHED

You have converted your activity relationships and space requirements into a selected layout plan by making a relationship diagram, a series of space relationship layouts, and an evaluation of alternative layouts.

You are now ready for the final step—planning the detailed arrangement of the physical items.

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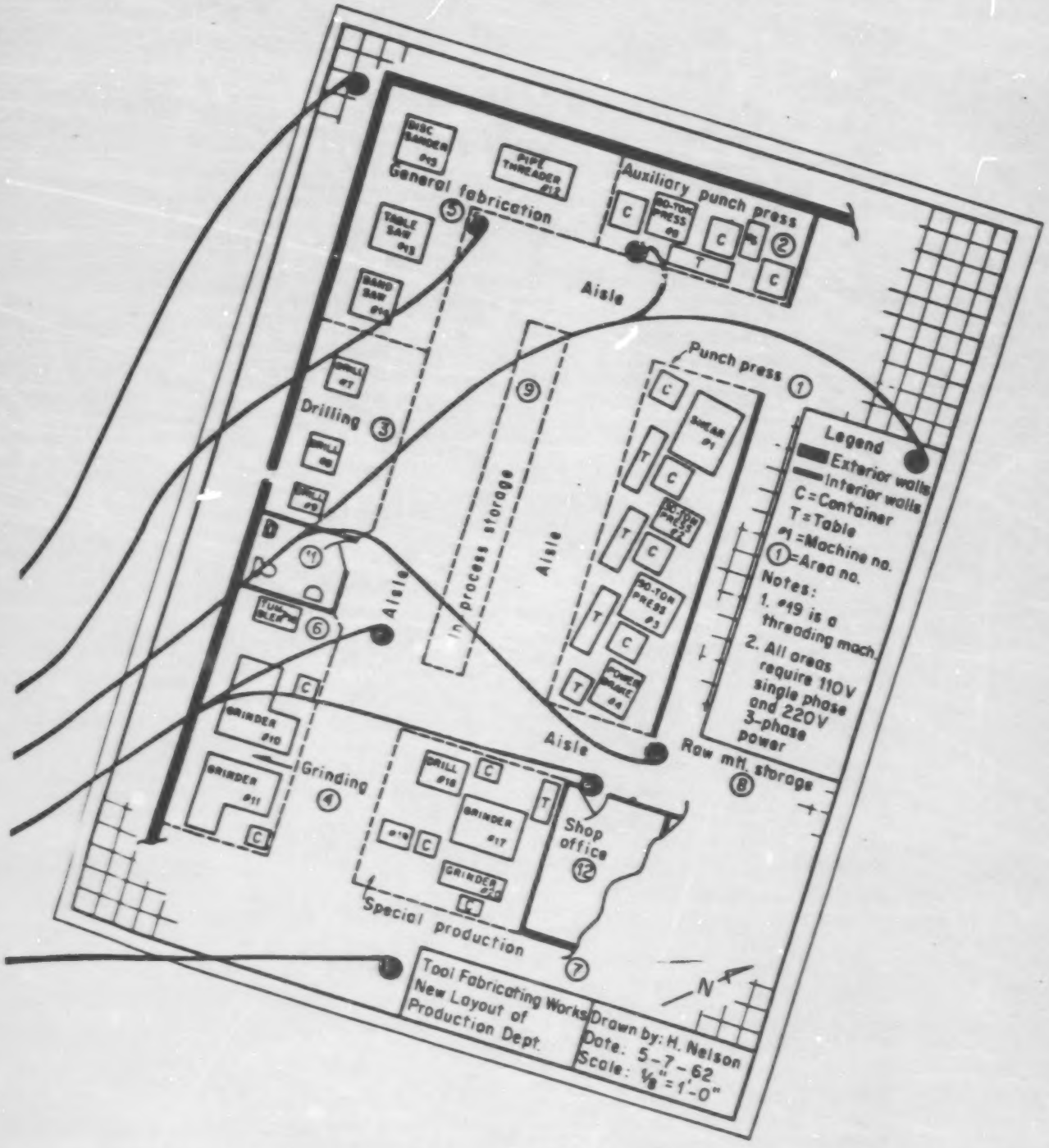

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For a more complex application of Step 6, turn the page

PHYSICAL PLANNING
FOR
ELECTRONIC SYSTEMS

PHYSICAL PLANNING FOR ELECTRONIC SYSTEMS

Offices will become more and more automated in the future -- by utilizing new technologies, such as miniaturization and electronic computerization. Records management has begun to use miniaturization in the form of microfiche and microfilm for less heavily used files -- if for no other reason than to conserve space. Computerization is especially relevant to:

data processing
word processing
paper flow
information flow
administrative support
records management
clerical operations
mail information transfer

Miniaturization implies the purchase and installation of microform readers, reader-printers and file cabinetry to hold the fiche or film. Except for electrical outlet requirements, microform technology does not require a reorganization of interior design requirements. (This statement may be somewhat modified in relation to floor loading. Microform cabinets, especially motorized units when fully loaded, tend to be even heavier than paper file cabinets (paper alone weighs 58 pounds a cubic foot). In fact, all film

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to be heavier than paper. Mylar map cases, for example, may weigh over 1200 pounds fully loaded! A heavily packed microform file area may cause a weak floor to collapse. Interior design requirements may have to be modified drastically when the floor of the office and its ability to bear weight is taken into consideration.)

On the other hand, computer technology often does require a reorganization with regard to interior design requirements. Because computer central processing units (CPU's) and terminals are electronic machines, requirements can be quite demanding and unique. The following requirements must be taken into consideration when installing new electronic systems: space, furniture and components, storage, power, future expansion, heating /ventilating/air conditioning, dust, noise, lighting fire and safety.

Before considering the design requirements, one must be aware of certain aspects of computer technology. The field itself is in a constant state of flux because it is a rapidly developing field. In the midst of all the changes taking place, two reverse trends are occuring simultaneously. One has to do with CPU's and terminals and the other is with regard to minicomputers. The CPU's and terminals are part and parcel of one system; one cannot function without the other. The trend here is to further upgrade peripheral electronic machinery as well as the main frame. This may mean more equipment will be added throughout the facility. In addition, a mass of wiring to connect one piece of equipment to another or to the CPU will be required. Even though newer CPU models tend to

be smaller and more compact, the extra peripherals take up more space.

The trend taking place in the minicomputer field is to be self sufficient yet increase capability by voluntarily hooking-up with other minicomputers or main frames. It is not necessary for mini's to be connected to a main frame, but by utilizing telephone equipment and connecting to some CPU's, more as well as instantaneous information can be obtained. A network of minicomputers allow access to one another's memory.

At the moment most organizations that are computerizing work processes are moving in both directions at once. Certain processes require centralization, and will be centralized utilizing a CPU or a series of CPU's located in a separate "clean room". Terminals throughout the system will be hooked up to it. Other work processes do not require centralization. These will be decentralized utilizing either stand alone equipment or equipment that affords access to larger data bases by telephone hook-up.

There are two areas to be evaluated when planning for the installation of a computerized system: the space for the CPU's and the space for the terminal(s). The space required for the CPU will vary depending upon the size of the equipment, but it is essential that adequate area is allowed for servicing, air flow and future expansion. At the minimum there should be three feet available on all sides of the CPU, permitting service engineers to get at the interior of the console when necessary. The three feet will allow, also,

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proper air flow. If the CPU is tucked into a corner, there may not be adequate ventilation or air circulation. Heat build-up will cause harm to sensitive electronic machinery.

Terminals need less space than CPU's. However, some terminals consist of display screens, keypads, and printers. In addition, telephone black boxes, modeums and other peripheral equipment may be required. Most often terminals are set on table or desk tops and placed near electric and telephone outlets. Each time a peripheral device is added to the terminal, another electric outlet is required. Furthermore, peripherals often eat up desk top or table space and take away any writing, storage or manuvering room. For this reason, adequate desk top space must be considered at the first juncture.

As the uses for the system grow, storage requirements tend to grow at the same pace. Therefore, it is advisable to plan for additional storage devices for both the CPU and the terminals at the time of initial installation. Whatever the storage medium, it must be accessible. Room must be made to store data processing forms, supplies and use/maintenance documents.

Power requirements are specified by the manufacturer(s) of the system. Electrical, heating, ventilation, air conditioning and humidity requirements fall within the scope of the work of the architects and/or mechanical engineers for each project. CPU's use more power than terminals. Power requirements for different systems can require 220/240 or 208 volts of input power. Terminals

may require only 110 volts on a 30 amp circuit. Most CPU's require dedicated circuits, some terminals do also. A dedicated circuit or line is straight from the main power box in the facility. The circuit does not have other equipment, such as air conditioning, heaters or lighting, attached to it. Some manufacturers prefer the installation of a separate, small circuit breaker panel just for the computer equipment alone. (Situations causing poor electric grounds or the use of non-dedicated circuits can introduce electrical noise which adversely affects the performance of the systems.)

When planning electric power for the system, future expansion should be considered. It is advisable to run at least another dedicated circuit for future needs. Then, too, in terminal areas and in main computer rooms, conventio al wall outlets should be located close to the equipment. These electrical outlets will be required by maintenance engineers to correct problems when and if necessary. It is not uncommon for maintenance engineers to need electronic testing devices and vacuums for normal servicing.

Because power requirements are so imperative, raised floor systems are usually required in main computer rooms. Electric and telephone cables placed underneath the floors can be accessed by lifting a floor tile or two. Another reason raised floor systems are so popular for main computer rooms are the CPU's penchant for air conditioning. CPU's depend upon electrons to be moved within the system at high speeds. This builds up electrical resistance and

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creates heat. High heat damages the system and causes failure. Internally, most CPU's should be kept at temperatures between 60^{o}-70^{o}F. By utilizing raised flooring systems, the air conditioning for the units can be located directly underneath them, cooling them down immediately. (Thermal specifications for computer terminals are not rigid. They run between 50^{o}F and 98^{o}F, although some peripherals have difficulties above 85^{o}F.)

Humidity control in main computer rooms is important -- especially in the south eastern states. In the winter, it is advisable to prevent humidity from falling below 40% or static conditions will build up (particularly on the print-out paper), causing the machines to malfunction. In the summer, it is advisable to keep humidity as close to 60% as possible -- a difficult, and in older facilities, a sometimes impossible thing to do. With humidity much above 60 - 75%, condensates can build up on the inside of the electronic equipment and short out the system.

Dust also affects the operation of a CPU, especially when it gets into the electro-mechanical storage devices. If possible, the CPU should be kept in a closed, private room where the air pressure can be kept higher than the rooms surrounding it. This will prevent dust from seeping in.

Another factor to consider is noise. Computer drives can be noisy. They have blowers which draw through air to cool the components and keep out dust. This noise is especially noticeable since the ambient noise levels in most facilities are low. Some peripherals

buzz. Impact printers cause a typewriter type of racket. If possible, acoustical ceilings and surfaces, and sturdy furnishings should be used in tandem with the electronic equipment.

Lighting is a critical factor when dealing with display screens (this is also important for microform readers). Glare on the display screen makes it difficult or impossible to read. The lighting should be adjusted accordingly. Baffles may be required to overhead lighting. Remote data transmission often requires certain telephone equipment. Terminal strips installed by the telephone company (similar to phone jacks) must be as close to the system as possible to hook up remote communications. Wires should be off the floor and installed in conduits so people will not trip over them. (This includes all wiring of any type -- for computer or microform systems -- or for anything requiring additional wiring!)

Automated Electronic Systems often work in tandem with other equipment and/or furnishings. For example, when an automated circulation system is installed on a circulation desk, the desk should be designed and the work flow studied so that the system functions properly.

With all electrical equipment, fire and safety precautions must be considered. Every staff member should be aware of where the emergency power shut off switch is located. In the event of a problem, the main plug should be easily shut off. To prevent total

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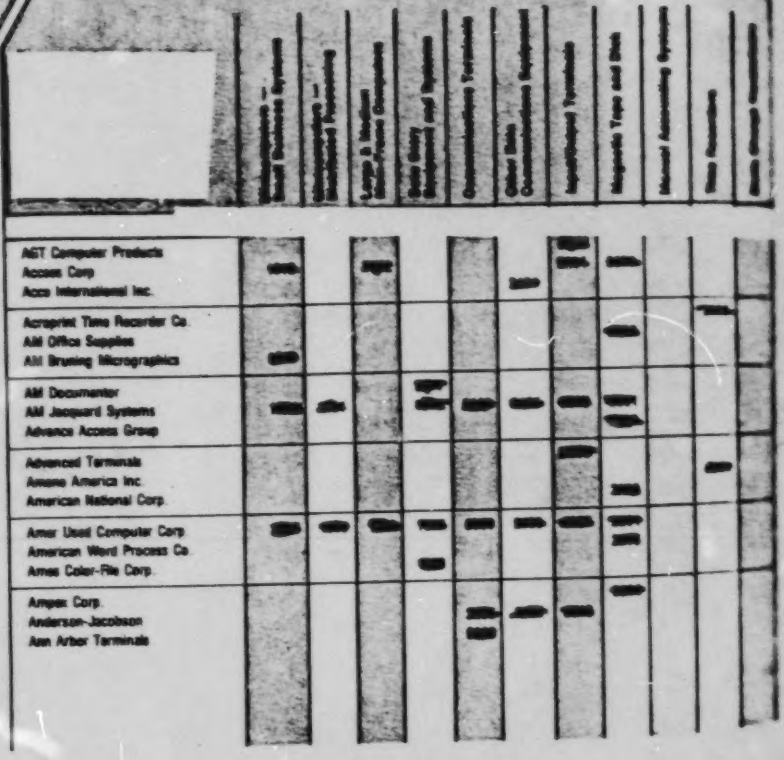
destruction of the system, a dry type of fire control should be used. Halogen systems are preferred in main computer rooms.

Data Processing

QUICK REFERENCE TO DATA PROCESSING



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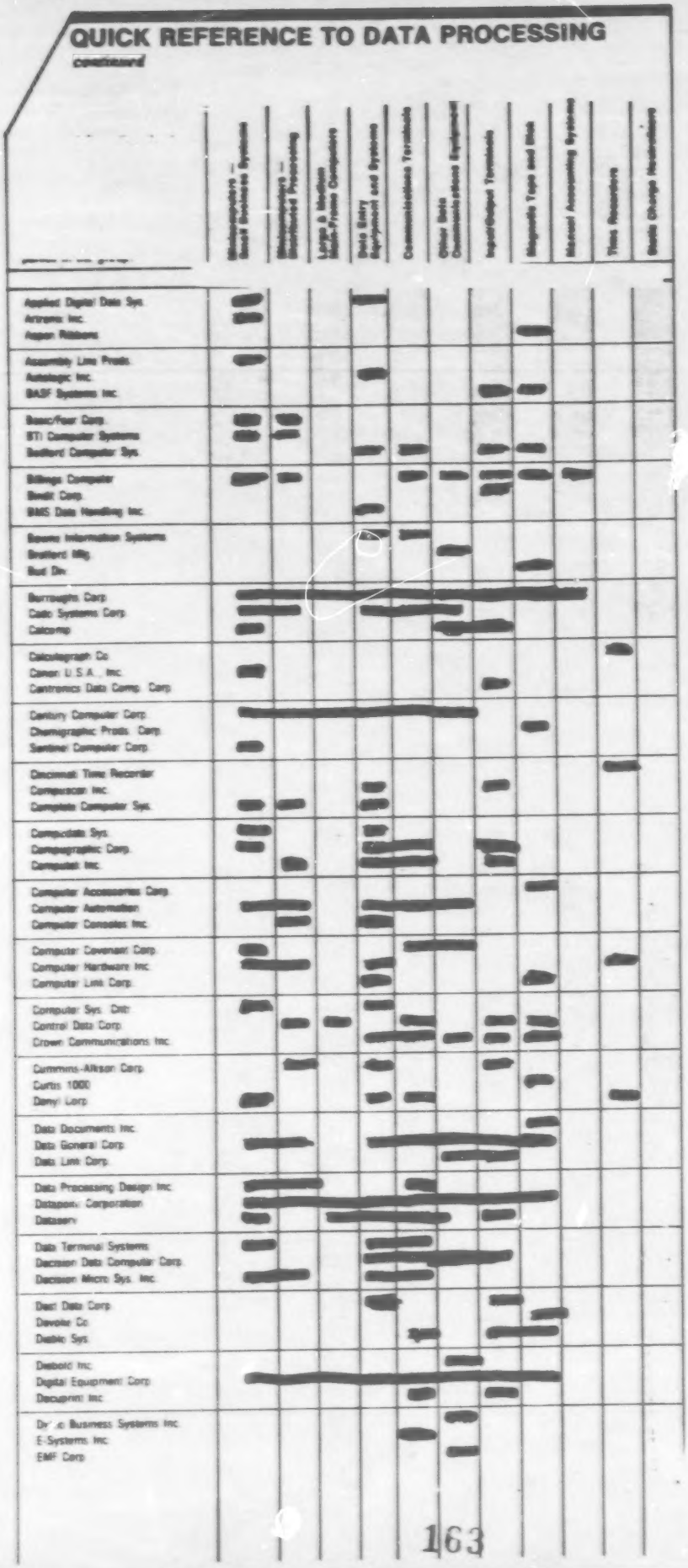

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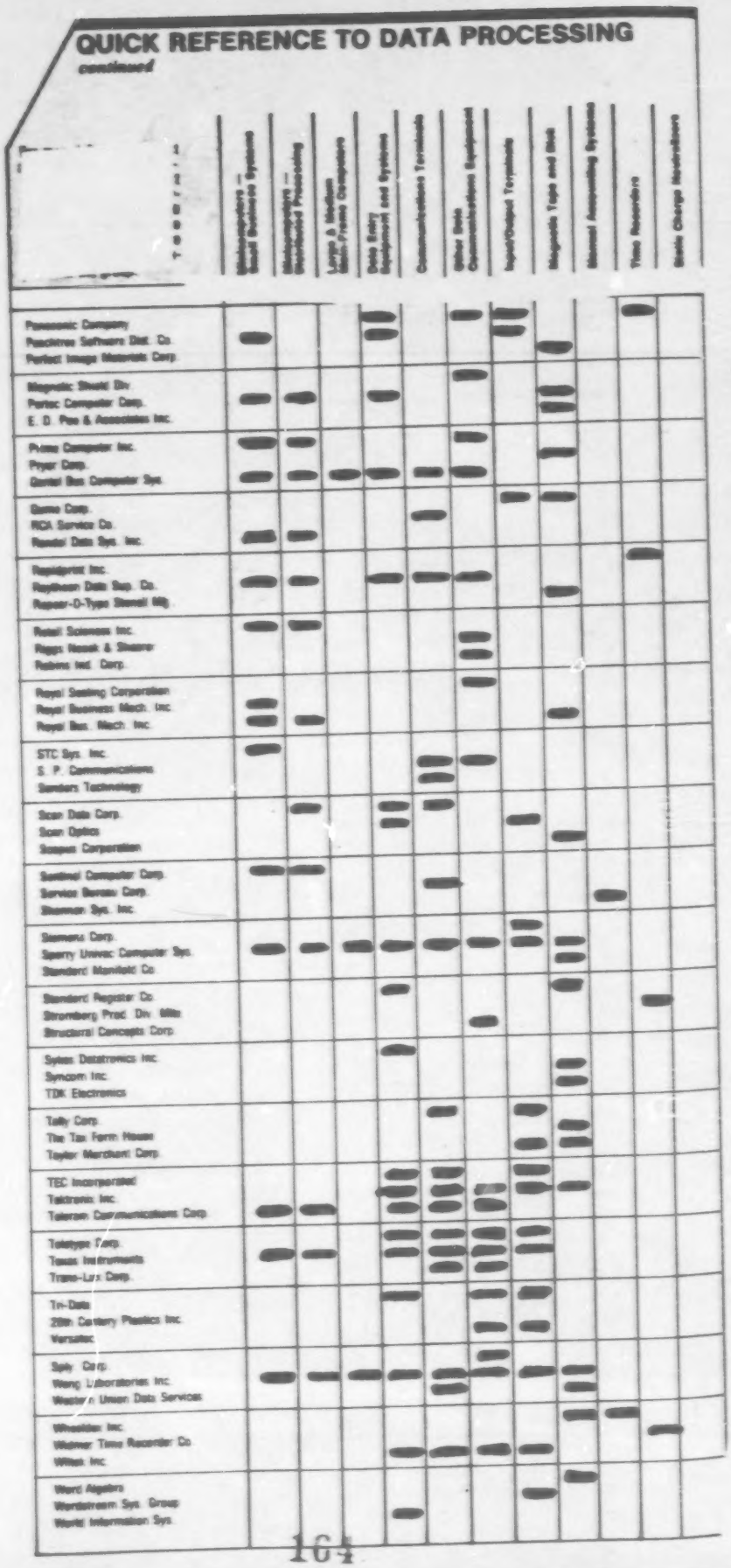

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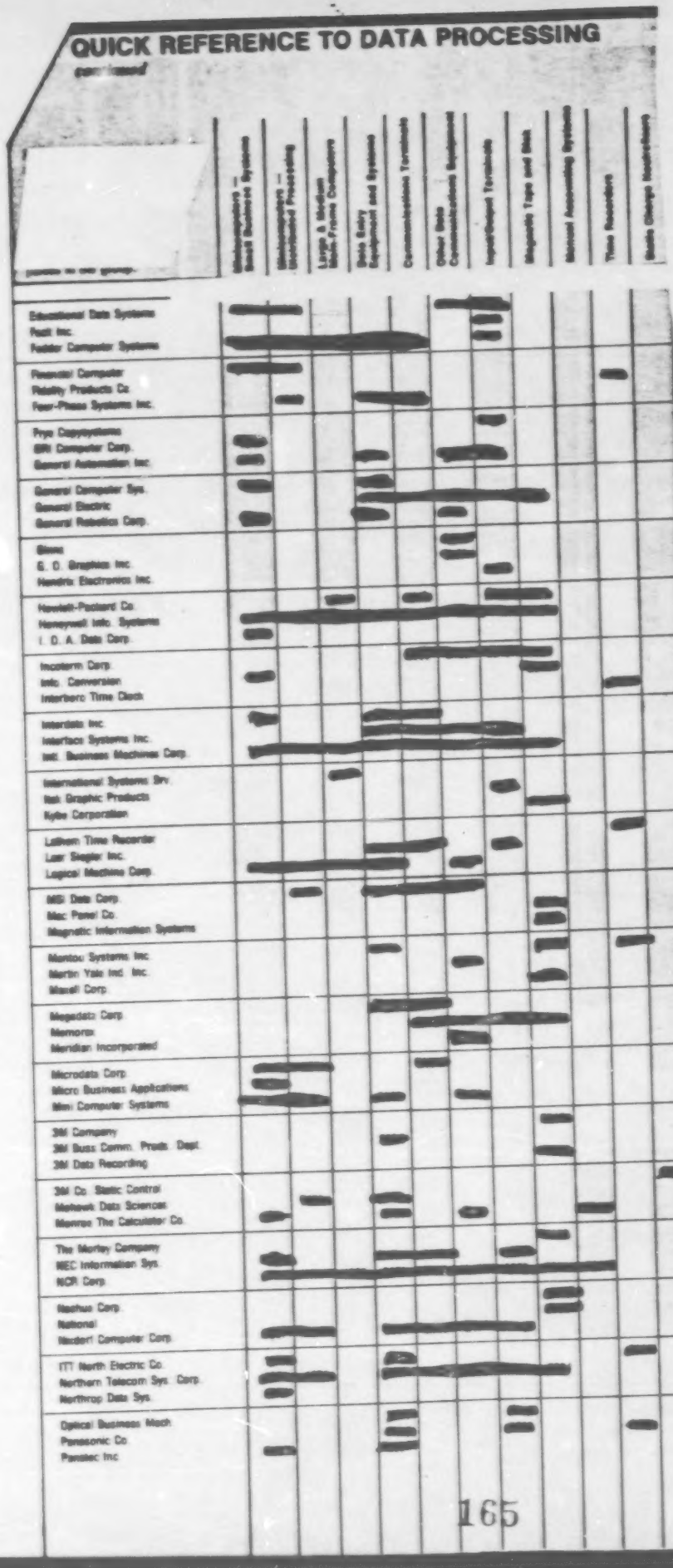

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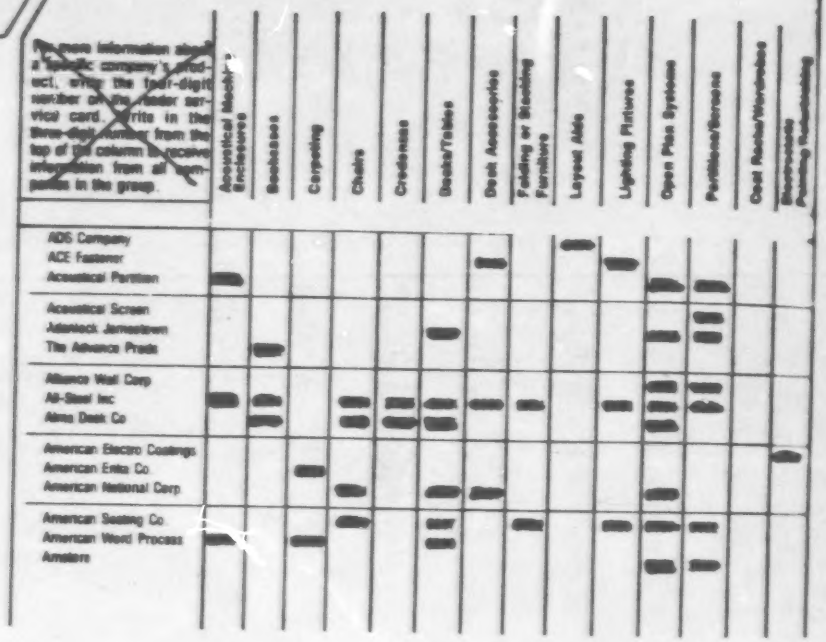
QUICK REFERENCE TO OFFICE DESIGN



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QUICK REFERENCE TO OFFICE DESIGN

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For more information about a specific company's product, write the four-digit number on the reader service card. Circle in the three-digit number from the top of the column to receive information from all companies in the group.

	Acoustical Machine Enclosures	Bookcases	Carpeting	Chairs	Credenzas	Desks/Tables	Desk Accessories	Folding or Stacking Furniture	Layout Aids	Lighting Fixtures	Open Plan Systems	Partitions/Screens	Coat Racks/Wardrobes	Electrostatic Painting/Refurbishing
Art Steel Corp Bassicks Corp E. T. Barwick Ind Inc														
Russ Bassett Co Bates Mfg. Co Harbor Benedetti Inc														
Bertsun Industries Inc Bigelow Sanford Bernie Furniture Mfg														
H. L. Berum Corp The Boling Co Brayton Intl. Collection														
Bretford Mfg Brewster Corporation Browne Morse Co														
Burroughs Business Efficiency Aids The Carter Company														
W.A. Charnstrom Chromcraft Corp Claridge Prod. & Equip														
Clarin Corporation Clipper Products Co Cole Business Furniture														
Columbian Art Works Commercial Carpet Corp Computer Accessories														
Computer Roomers Inc Conrad Corp Crown Industries														
Courtstan Inc Cramer Inds Datatech Bus. Mach.														
Hal David Co Daves Furniture Ind. Inc Decorative Frsts Inc														
Deflecto Corp Delco Associates Inc Demco														
Devoke Co Discovery Concepts Do More Off. Furniture														
Donn Corporation Dresden Systems Ltd Drier Inds														
Dunbar Duro-Test Corp Frank Eastern Co							3364	3429						
Eck Adams Corporation Edward Axel Roffman Elson Office Products							3365	3430						
Epenger Furniture Inc Essette Pendaflex Corp Essey Corp							3366 3367							
Evans Specialty Company Executive Furniture Inc Faber-Castell Corp							3368							
Fabri-Coate Facit Inc Falcon Products														
Fidelity Products Co Firth Carpet Fixtures Mfg. Corp														

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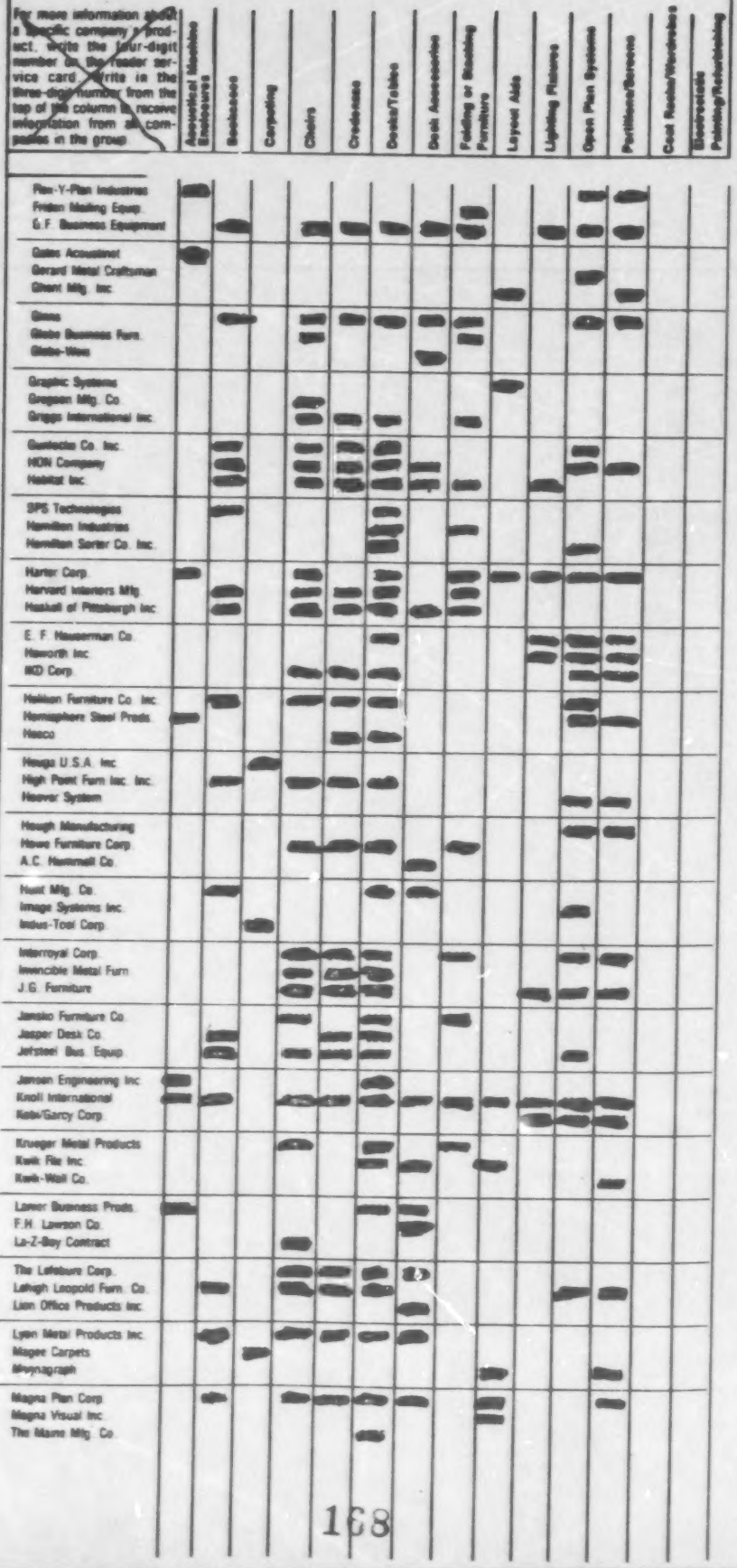

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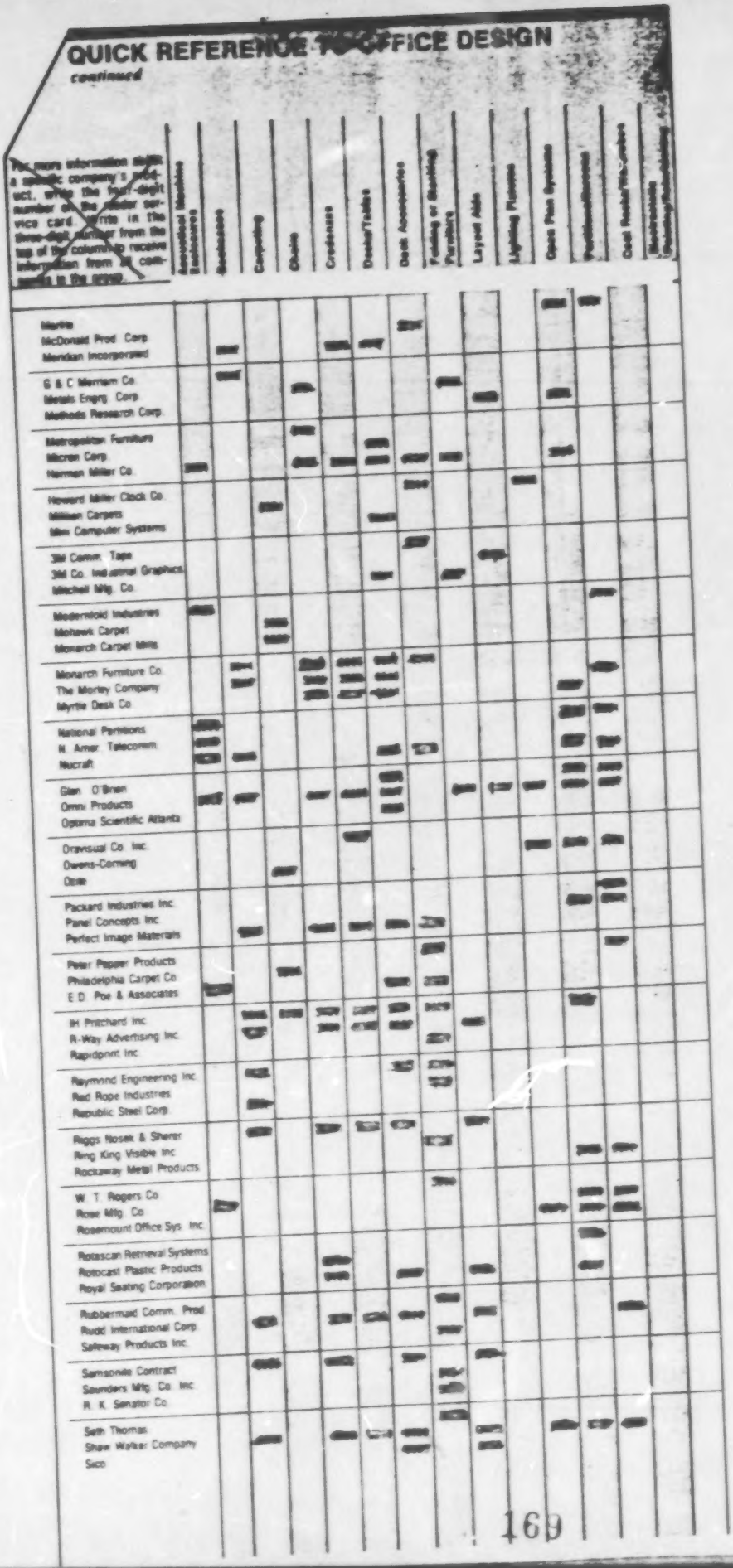

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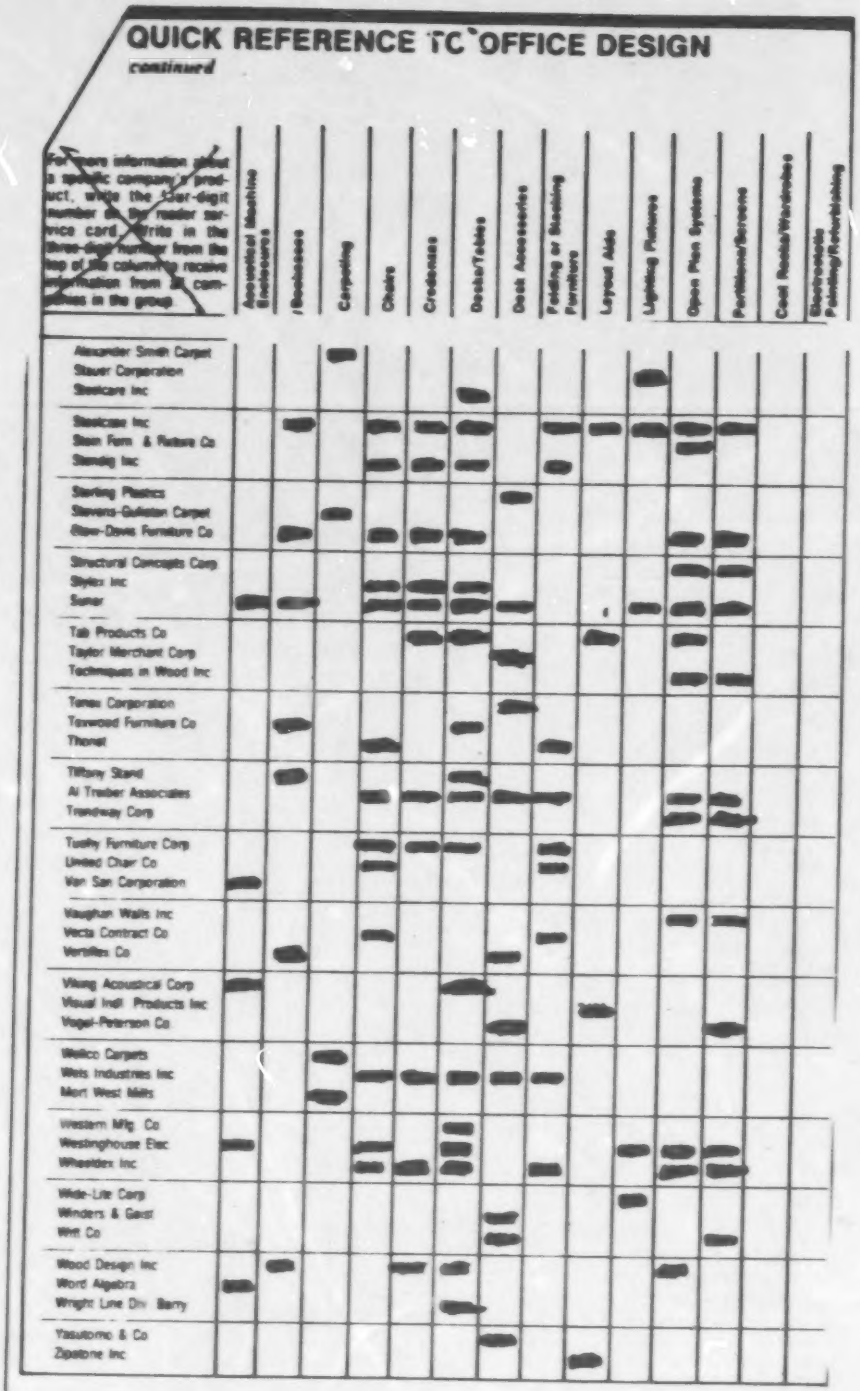

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Word Processing

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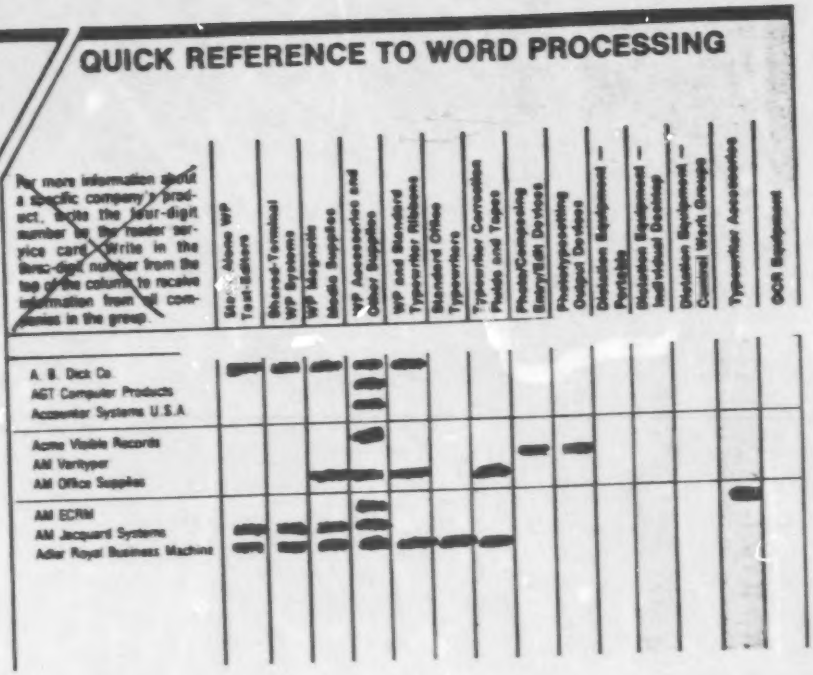
For more information about a specific company's product, locate the four-digit number in the reader service card. Write in the three-digit number from the top of the column to receive information from all companies in the group.
Stand-Alone WP Text-Editors
Shared-Logic WP Systems
WP Magnetic Media Supplies
WP Accessories and Other Supplies
WP and Standard Typewriter Ribbons
Standard Office Typewriters
Typewriter Correction Fluids and Tapes
Photo/Composing Entry/Edit Devices
Phototypesetting Output Devices
Dictation Equipment — Portable
Dictation Equipment — Individual Desktop
Dictation Equipment — Central Work Groups
Typewriter Accessories
OCR Equipment
A. B. Dick Co.
AGT Computer Products
Accesstor Systems U.S.A.
Acme Visible Records
AM Varityper
AM Office Supplies
AM ECRM
AM Jacquard Systems
Adler Royal Business Machine

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QUICK REFERENCE TO WORD PROCESSING

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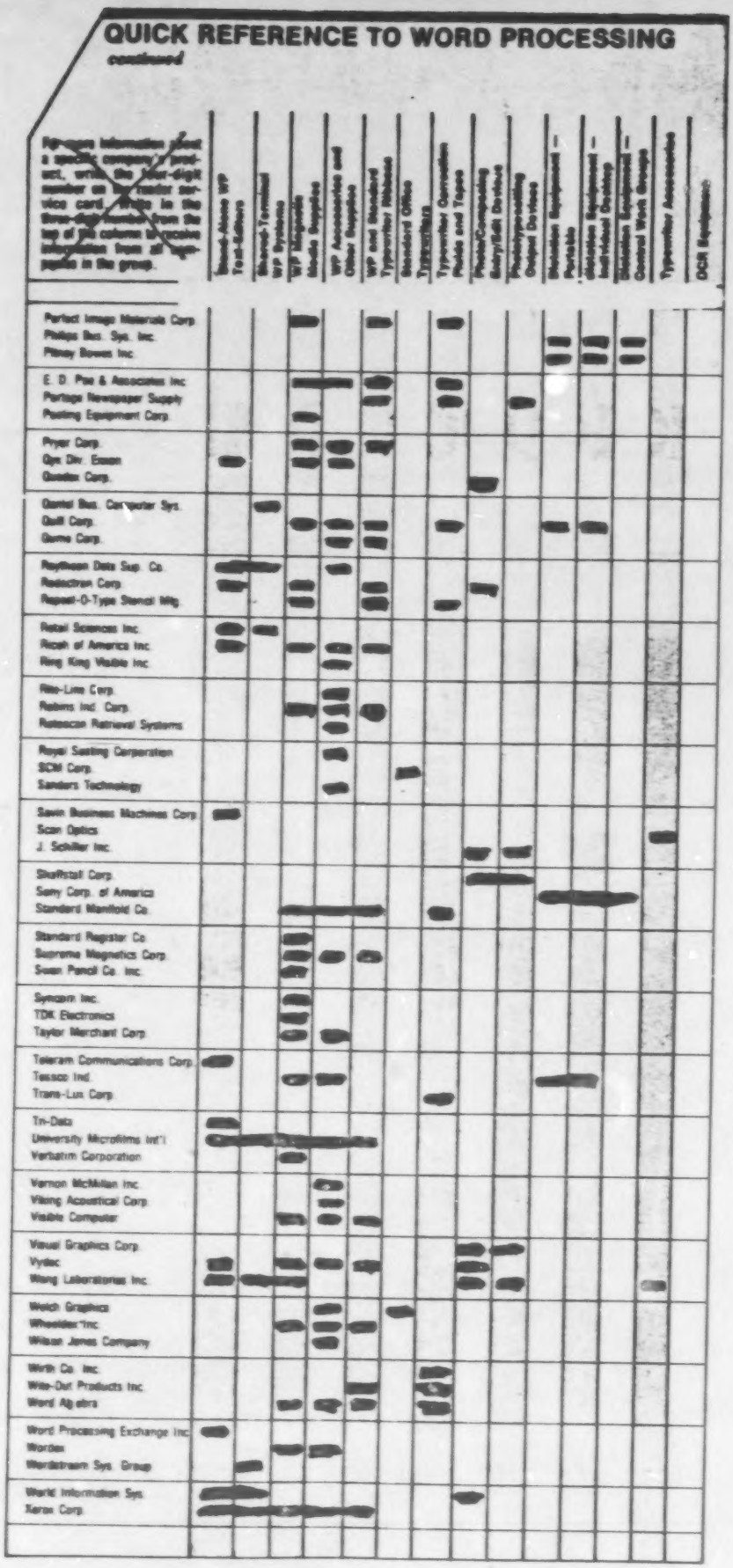

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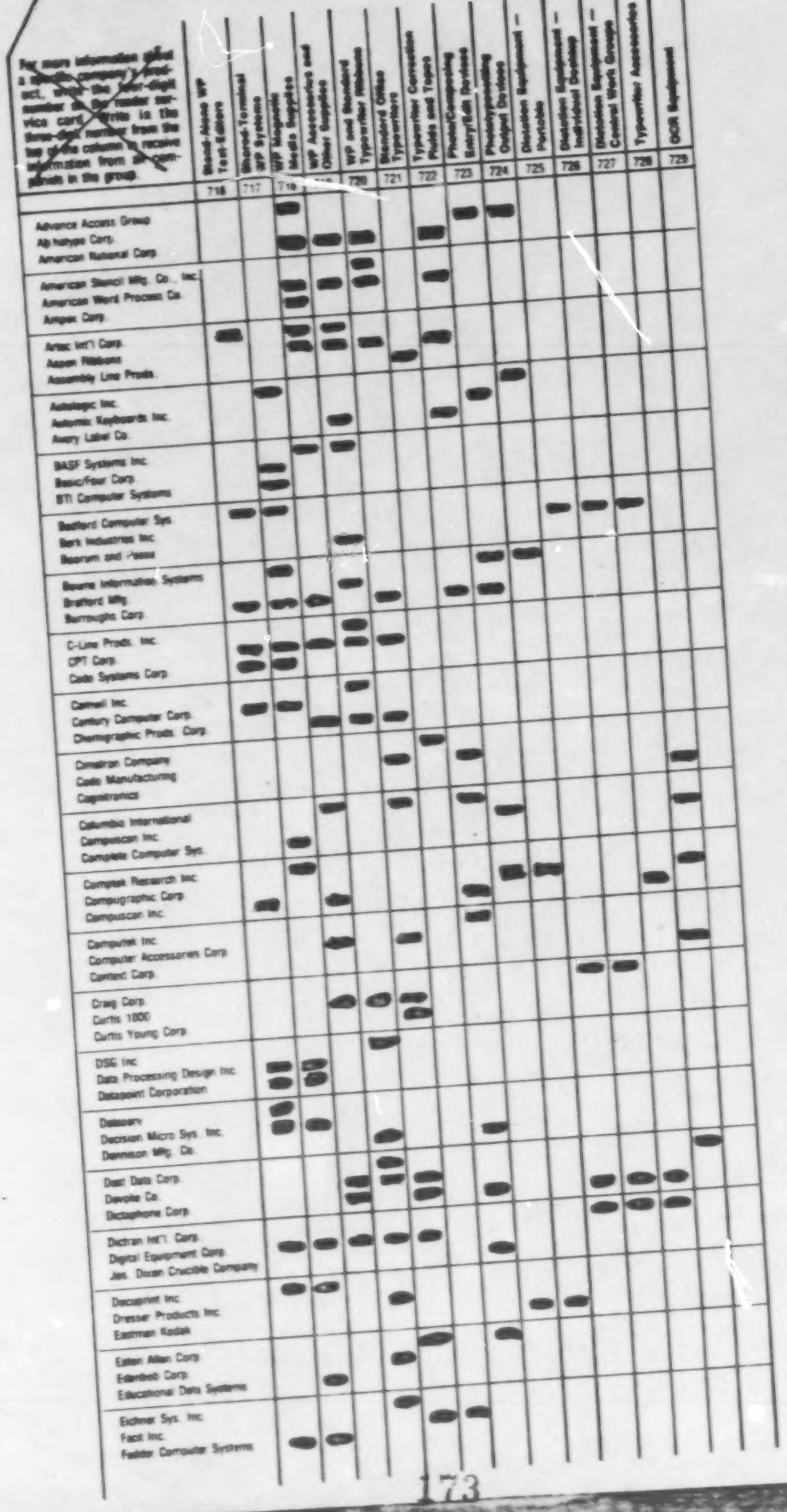

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QUICK REFERENCE TO WORD PROCESSING
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For more information about a specific company's product, write the four-digit number under its name in the service card. Write in the numbers from the following columns for information from all the companies in the group.

	Stand-Alone WP	Text-Editors	Shared-Terminal WP Systems	WP Magnetic Media Supplies	WP Accessories and Other Supplies	WP and Standard Typewriter Ribbons	Standard Office Typewriters	Typewriter Correction Fluids and Tapes	Photo/Composing Entry/Edit Devices	Phototypesetting Output Devices	Distation Equipment — Portable	Distation Equipment — Individual Desktop	Distation Equipment — Central Work Groups	Typewriter Accessories	OCR Equipment
Financial Computer															
Ford Industries Inc.															
Four-Phase Systems Inc.															
Frankel Mfg. Corp.															
Franklin Ribbon & Carbon Co															
Fryc Copysystems															
G. P. Industries															
GRI Computer Corp.															
General Computer Sys.															
General Electric															
Gerss															
G. O. Graphics Inc.															
Graphic Systems Inc.															
Hamilton Sorter Co. Inc.															
Hendrix Electronics Inc.															
Hermes Products Inc.															
I. S. Joggers															
Imaging Systems Corp.															
Imtec Corp.															
Information Management Corp.															
Interbors Time Clock															
Int'l. Business Machines															
Itek Graphic Products															
Kray Industries Inc.															
Kybe Corporation															
Lanier Business Prods.															
Lee Products Co.															
Leetron Corp.															
Liquid Paper Corp.															
Litho-Art Products Inc.															
Lorer Corp.															
Magnetic Information Systems															
Magnetic Ribbon Corp.															
Mosell Corp.															
Mead-Hatcher Associates Inc.															
Magedata Corp.															
Memocord U.S.A.															
Memorex															
Mergenthaler Linotype Co.															
Micom Co.															
Micro Business Applications															
Micron WP Supplies															
3M Company															
Mohawk Data Sciences															
Moore Business Forms Inc.															
The Morley Company															
M.B.I. Corp.															
MTI Bus. Equip. Limited															
Nashua Corp.															
National															
Nixdorf Computer Corp.															
Nixdorf Computer Corp.															
Norelco Dictation Sys.															
N. Amer. Telecommunications															
Office Data Products															
Olivetti Corp. of America															
Olympus															
Optical Business Mach.															
Optical Coating Lab															
Peachtree Software Dist. Co.															

QUICK REFERENCE TO BUSINESS SECURITY

For more information about a specific company's product, write the four-digit number on the reader service card. Write in the three-digit number from the tag of the column to receive information from all companies in the group.

	Access Control Systems and Alarms	Fire Alarm Systems	Guard Services	Key Control Systems	Photo/Identification Systems	Safes	Shredders	Time Clocks	Protection Devices
Allegheny Bus. Sys. Inc American Security Products American Word Process Co.									
Anchor Pad Intl. Inc Assembly Line Prods Avant Inc.									
BPK Electronics Best Lock Corp Brass Company									
John D. Brush & Co. Burns Intl. Security Ser. Inc. Card Key Systems									
Continental Instruments Corp Cummins-Allison Corp. Data Pac Mailing Sys.									
Datatach Business Machines Detex Corp. Devoke Co.									
Diebold Inc. Diversified Electronics E-Systems Inc.									
Elec. Wastebasket Corp. Envopak America Inc.									
Equipment Co. of Amer. General Binding Corp. Ginns									
I.D.A. Data Corp. ITT North Electric Co. Identicard Systems Inc.									
Indl. Shredder & Cutter Co. Jefstee Bus. Equip. Ke-Master									
Key Control Systems Inc. Laminex Inc. Lafebure Div.									
Lund Equipment Co. Inc. Makers Equipment Co. Mesinai Safe Co.									
Michael Business Mach. 3M Co. The Morley Company									
Mosler Murphy Mfg. Co. NSC International Corp.									
Panasonic Company Park Sherman Perfect Image Materials Corp.									
Polaroid Corporation I. D. Prague Corp. Pyrotronics Inc.									
Quali Corp. Rusco Electronic Sys. Schlage Electronics									
Schwab Safe Co. Inc. Shredmaster Corp. Simplex Security Sys. Inc.									
Simplex Time Recorder Co. S.R. Smith Co. Inc. Speed O Print									
Stauer Corporation The Steward Co. Telkee Inc./P. D. Moore Co.									
Tepco Av Control Sys. Victor Sys. Xardex Rel Wagoner & Assoc.									

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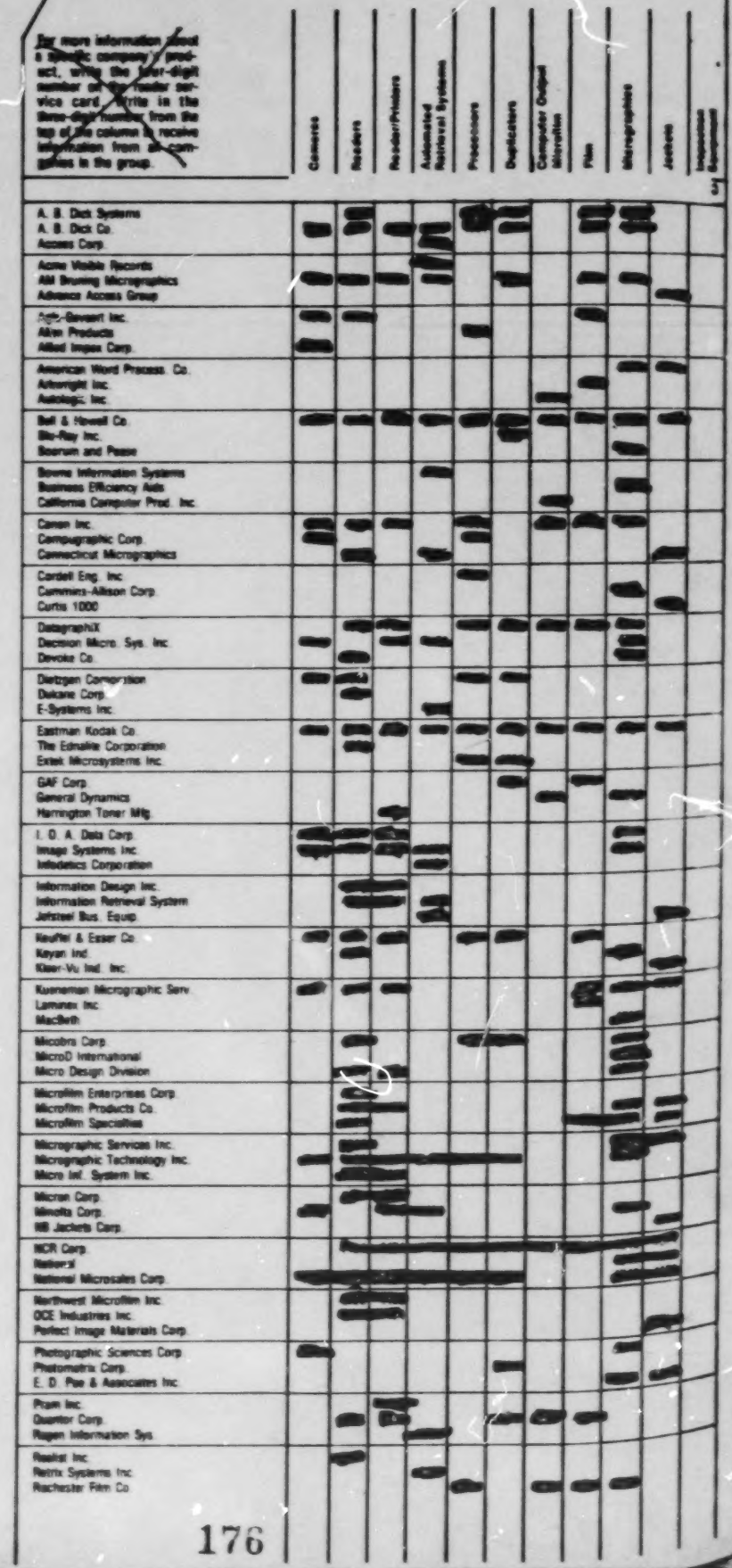
QUICK REFERENCE TO MICROGRAPHICS

For more information about a specific company / product, write the three-digit number on the reader service card. Write in the three-digit number from the top of the column to receive information from all companies in the group.



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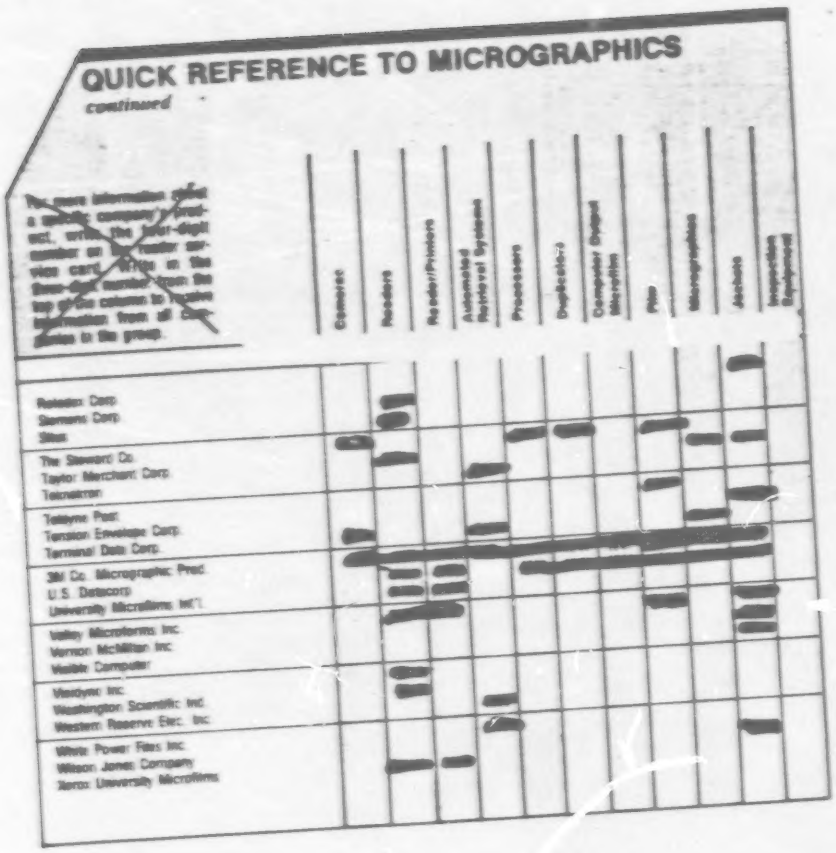

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QUICK REFERENCE TO DOCUMENT STORAGE AND RETRIEVAL

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QUICK REFERENCE TO DOCUMENT STORAGE AND RETRIEVAL

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For more information about a specific company's product, write the four-digit number in the reader service card. Write in the three-digit number from the top of the column to receive information from all companies in the group.

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QUICK REFERENCE TO DOCUMENT STORAGE AND RETRIEVAL

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For more information about a specific company's product, write the four-digit number on the reader service card. Write in the three-digit number from the top of the column to receive information from all companies in the group.

	Data Binders	File Supplies	File — Bin or Tub	File — Data Binder Racks	File — Drawer	File — Insulated	File — Lateral	File — Mechanized	File — Mobile	File — Transfer/Storage	File — Visible Record Systems	Shelving
Reflect-o-r Hardware Corp.												
Republic Steel Corp.												
Retrix Systems Inc.												
Riggs Mower & Shearer												
Ring King Visible Inc.												
Rockaway Metal Products												
Rolodex Corp.												
Rotascan Retrieval Systems												
Royal Sealing Corporation												
Royal Bus. Mach. Inc.												
Rudd International Corp.												
Safco Products Co.												
Saunders Mfg. Co. Inc.												
Schwab Safe Co. Inc.												
Scopus Corporation												
Shannon Sys. Inc.												
Shaw Walker Company												
Smead Mfg. Co.												
Smith System Manufacturing												
Spacesaver Corp.												
Standard Register Co.												
Steelcase Inc.												
Stendig Inc.												
Sterling Plastics												
The Steward Co.												
Stor Trac Corp.												
Sumar Div. of Hausermann Ltd.												
Supreme Equip. & Sys. Corp.												
Tab Products												
Taylor Merchant Corp.												
Tennsco Corp.												
Tiffany Stand & Furniture Co.												
20th Century Plastics Inc.												
Tuohy Furniture Corp.												
United Business Equip. Inc.												
V. R. E. Inc.												
Vari-Bind												
Vernon McMillan Inc.												
Vertiflex Co.												
Viking Acoustical Corp.												
Visible Computer												
Visirecord Systems												
Visi-Pak Co.												
Visilox Inc.												
Vulcan Binder & Cover												
Warshaw Mfg. Co. Inc.												
Watson Mfg. Co.												
Wells Industries Inc.												
Wheelden Inc.												
White Power Files Inc.												
Wilson Jones Company												
Witt Co.												
Wright Line Div. Barry												
Xerox University Microfilms												

FACTORS TO CONSIDER MICROFICHE READER/PRINTER

1. Image, Print Quality
2. Index Technique (grid indexing)
3. Ease of Operation
   - A. Automatic Opening of Film Platen
   - B. Focus
   - C. Print Contrast
   - D. Positive Print from Positive or Negative Film
4. Dual Magnification
5. Ease of Maintenance
6. Shelf Life and Cost
7. Purchase Cost

MICROFORMS

1. Indexing
2. Filing Equipment
3. Furniture
4. Lighting Indirect
5. Retrieval Equipment

16mm ROLL FILM READER PRINTER - EVALUATION CRITERIA

1. Screen Image and Print Quality
2. Ability to Handle Cartridge and Open Reel Film
3. Indexing Technique Odometer
4. Operational Controls
   - A. Auto Film Loading and Feeding
   - B. Variable Speed
   - C. Focus Controls
   - D. Print Contrast Controls
   - E. Image Rotation
   - F. Vertical Scan
   - G. Positive Print from Positive or Negative Film

5. Maintenance

6. Shelf Life and Cost

7. Purchase Cost

CABINETS - ROLL FILM

1. Spacesaver - W 23 3/4", H 90½", D 28½"
   Capacity - 1330 - 35mm
   2235 - 16mm
   Total Square Footage - 15 to 20 square feet
   Approx. equivalent vols. per square foot - 300 - 35mm
   Cost per reel - $1.02

2. Standard Cabinet - W 20½", H 52", D 29"
   Capacity - 576 reels - 35mm
   900 reels - 16mm
   Total Square Footage - 15 to 20
   Approx. equivalent vols. per square foot - 90
   Cost per reel - $1.32

3. MicroVox - on Shelves - W 4½", H 9", D 9"
   105 boxes per section
   840 reels per section (35mm)
   15 square feet per section
   Vols. per square foot - 105 (35mm)
   Cost per reel - $.48 (35mm)

CABINETS - MICROFICHE

1. Spacesaver - W 15", H 52", D 28½"
   Capacity - 16,690 or 40 per inch
   Cost - $560

2. Wide Trace - W 39", H 57", D 35"
   Capacity - 6,000 in 20 separate trays

3. On Shelf - 3 ring binder each panel holds 20 microfiche

VARIOUS COSTS

1.	Shelf Cost Per Microfilm Volume	.90+
2.	Annual Storage Cost Per Microfilm	.041
3.	Annual Storage Cost Per Microfilm Volume	.016
4.	Number of Microfilm Reels Per Square Foot	120
5.	Number of Microfilm Volumes Per Square Foot	300
6.	Square Footage Required By Station	20 to 40
7.	Estimated Life Of Microfilm Equipment	5

FURNITURE

F U R N I T U R E

In the late 19th and early 20th century, when one thought of office furniture one thought of objects that were large, solid and made of wood. That "look" still exists today -- but only as expensive furniture located in the executive suite. The rest of us must make due with office furniture comprised of a substructure of steel, composition board and perhaps mineral fiber acoustical insulation. Desk tops and side panels are covered by plastic laminates, veneer, enamel or fabric -- or a combination of all four.

Furthermore, office furniture must satisfy new requirements. Offices are in a constant state of flux. Even small companies find it necessary to arrange and rearrange their offices as departments expand and contract and as needs constantly change. Furniture must be able to fit into new and different situations. The electronic revolution has impacted office furniture requirements as well. Constant wiring and rewiring, additions and changes of equipment needs make office furniture and electronics partners in the revolution. Desks and tables support equipment, while the empty spaces within their substructures are required to hide a myriad of wires that interconnect electrical and communication networks.

Rearrangement and wiring is difficult with solid furniture. Solid furniture tends to be very heavy, takes up a lot of space and does

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not allow wiring to be easily hidden. As for wood, in recent years costs have risen to such an extent it is doubtful any except the most prestigious offices will receive anything but the thinnest veneers covering standard steel office furniture units.

In an office, work flow must have top priority. Since the 1950's office contract companies have developed modular furnishing systems that offer great improvements over the more traditional types. These systems are designed to be eminently flexible. Desks can be purchased with: more than one work space, shelving above and below the work surface, slotted areas for paper storage, rollaway files, lazy susans for shared terminals, built-in lockable cabinets, prewired electric/CRT/communication outlets and even walls. Most modular systems have some components that can be slipped in and out as needed. These systems offer variations for the common desk/office arrangement. The variations are commonly known as the workstation.

The workstation concept is different from the office/desk arrangement. Traditionally, employees were supplied with a desk, either in a confined space (cubicle or office), or in a large open area with many other desks (bull pen). Little use was made of the space above desk top height. This air space was ignored. Then, too, as an employee's responsibilities increased, so did the pieces of furniture, spreading work all over the place. For instance, guest chairs may be adopted as secondary work surfaces, to temporarily hold papers and files. Or an old table may be captured

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to hold books and plans. Needed files may be located in file cabinets half way across the department because there is no room nearby.

In the workstation concept, all the cabinetry, drawers, files, workspaces and surfaces required by an individual to do a job are located within arm's reach -- or within one's own personal workspace. This includes the space above and below the desk top and "walls". L and U shaped arrangements are common so that employees may have a primary, secondary and even tertiary task surface. If systems furniture is used, the workstation does not have real walls. The furniture and equipment within the personal workspace form partitions which create offices of various sizes. The partitions can be arranged and rearranged easily, changing with departmental, staff adjacency and equipment requirements -- in many cases in a matter of an hour with one simple tool.

There are two basic types of modular workstation furniture -- or systems furniture as it is called. (It is also known as office or open landscape.) In the first instance, furniture and equipment component parts are glued, pinned, screwed or clamped together in the factory and delivered on site in one piece. Workstations are formed by ordering matching furniture, equipment and panels.

Individual offices may be created by free standing panels, panels which lock onto the furniture, or by file cabinet arrangements. In the second instance, furniture is delivered "knocked down" (in pieces) and must be assembled on site. Basic components depend upon panels which form all major work surfaces and partitions. Nearly all other parts canteliver from these panels. Panels come in a variety of heights: 30" desk top, 48" countertop, 64" privacy height, etc. Many components are interchangeable and connect together in a variety of ways. While one workstation may contain primary workspace, extensive shelving and file cabinets, another may contain primary, secondary and tertiary worksurfaces and file cabinets using many of the same parts. Cabinetry, drawers, etc., may be added or deleted at will. The size and the configuration of the work surfaces depend upon workstation requirements. Panels can be connected one to another endlessly to form a variety of patterns. (The three basic patterns are: rectilinear, hexagonal and random.)

The unitized systems, the first type of modular workstation, tend to be slightly less expensive than the panel systems. They also tend to be easier to handle and, therefore, more popular for small companies or for localized applications (perhaps furniture already exists and a few pieces are necessary to turn the area into an open landscape office). The panel systems tend to be a better purchase for the larger corporations where requirements are constantly changing -- and where the maintenance staff is capable of doing some of the changing without outside aid.

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Although many systems furniture dealers offer service contracts, it is still better to be able to do at least some of the work in-house. Then, too, storage of spare parts may be a problem for smaller corporations, but not for larger ones.

At least one major office furniture corporation manufactures both types of systems furniture so that corporations can begin to open landscape with one type and switch to the other as needs grow or change.

Besides the flexibility inherent in systems furniture, there are many other reasons systems furniture has taken the industry by storm. One of the primary reasons is that systems furniture cuts down the costs of construction. Office buildings need to be only large loft spaces with few if any interior walls. Without large corridors, more working space per square foot may be captured. Then, too, overhead lighting need not be installed in the loft spaces. Many systems provide task/ambient light -- a combination of desk lamps and indirect lighting built into the units. (In this instance, many companies still prefer some overhead lighting, but cut down on the amount of fixtures and depend upon built in desk lamps to do the job.) HVAC requirements are not as stringent. Since there are few if any floor to ceiling walls, the heating, ventilating and air conditioning ducts can be located on a simple grid pattern. Wiring requirements also are not as stringent. The furniture wiring systems can provide linkage from floor or

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ceiling junction boxes to any area on the office floor. And last but not least, systems furniture provides substantial tax benefits. Construction costs can only be depreciated over 20 years, while furniture costs can be depreciated in 10 years, or half the time. If the walls, lighting and wiring can be part and parcel of the furniture system rather than part of the construction, they too can be depreciated in 10 years.

In recent years, however, office landscape has been severely criticized. First and foremost, the systems are seen as methods of limiting employee privacy. One concept upon which the idea of office landscape rests is that most office workers do not need noise privacy, and that only a limited number need total visual privacy. But this is not accurate. The majority of the American workers require enough noise privacy that they cannot distinguish individual sounds, and enough visual privacy that, when seated, they cannot see other people walking around. This means, in effect, that floor to ceiling office or cubicle walls are desirable to many. A panel with some sound absorbing qualities that is high enough so that a seated worker cannot see over it also will do the trick. The overwhelming majority of American workers cannot see over a panel that is 5'4" high when they are seated. But most feel they are being spied upon (the Big Brother Syndrome).

Another concept important to office landscape is the idea that office doors are superfluous. Few American office doors are ever closed. Thus, orienting workstations so that limited privacy can be provided for the occupants is sufficient. This is viewed as another Big Brother effect of an anonymous employer.

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any office furniture manufacturers offer doors on panels that are less than approximately 6'8" high. And until recently, even those panels came without doors. At this time, because of consumer demand, more and more furniture companies are manufacturing high partitions featuring doors. In fact, some of the companies are manufacturing totally enclosed rooms, complete with lighting and HVAC systems. More important, the office landscape must provide the capability for easy workflow and paper flow. Employees must not be closed off from one another.

The most vociferous opponents of open landscape systems claim that the low partitions are not sufficient to prevent noise and other distractions. The open doorway provides constant distractions as other workers walk by. Others complain that although open landscape is supposed to provide personal workspace, even a feeling of personal territory, the low partitions and the random effect of one cubicle after another makes employees feel as if they are rats walking in a maze. The systems are dehumanizing.

Workers on all levels share some of these complaints, but study after study has shown that secretaries and clerks decidely prefer open landscape over bull pens. They see open landscape as a step up. The bull pen arrangement is more dehumanizing and offers more distractions. On the other hand, middle managers

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and people moving up the corporate ladder view open landscape as a step down from conventional offices. One of the reasons for this is that the most visible status symbol is the office: the size and decoration of individual offices. Large enclosed offices with several windows and handsomely appointed furnishings are viewed as the ultimate status symbol. An enclosed office, any size, any type, offers some status delineation, and separates the middle manager from the more "regular" staff. An enclosed office symbolizes worth.

To overcome the discontent with open landscape offices, education and substitution is necessary. Workers must view the new office concepts with a different perspective. In some instances they will do so on their own. Managers are now focusing on space standards as a status symbol, although size and decor is still available as a status symbol.

In a survey of top corporations, the following space standards are common. (Notice that the standards within a category vary greatly. Certain corporations are more generous with space than others. Also some continue to use conventional offices in many areas.*

LEVEL	SPACE STANDARD
Top Executive	200 - 300 sq. ft.
Middle Manager	175 - 250 sq. ft.
Low Middle Manager	120 - 225 sq. ft.

* Many companies prefer a "modified plan" -- a mixture of conventional offices and open plan offices. For some, the conventional offices are symbols of managerial level. In other instances, the conventional offices are retained for those who require heavy concentration. A modified plan does tend to break up the space, and for large areas tends to be more pleasing to the eye.

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LEVEL	SPACE STANDARD
Professional	100 - 200 sq. ft.
Technical	80 - 125 sq. ft.
Clerical	50 - 90 sq. ft.

Add 15% for traffic circulation.

Another reason for the disaffection has to do with the orientation of desks in the panel systems. If the desks must be cantelivered from the enclosing panel, more than likely the employee will face away from the cubicle opening and towards the panel. People feel vulnerable with their backs towards the "doorway" and staring towards a "wall." Their backs are unprotected. By simply turning the desk, placing it at a 90° angle to the doorway, the problem will be alleviated. Of course, facing the desk directly toward the doorway, as in a traditional arrangement, may be an even better arrangement (in other words the desk cantelivers from the panel on only one small side, the other side rests on the floor). In this situation, it may be necessary to make the cubicle open into a bit of a labarynth so the visual distractions of the corridor are removed.

The noise problem is not a difficult one if simple acoustics are understood. When systems furniture first became popular, many were installed with total disregard to the enclosing space's acoustics. Window walls, hard surfaced overhead lighting fixtures, tile floors and ceilings without acoustical tile caused

many difficulties. It is now understood that the enclosing space has to be treated; acoustical ceiling tile, carpeted floors, "acoustical" lighting fixtures, draperies on window walls, acoustical wall finishes are necessary. The larger corporations also use "white noise" systems to mask sound. In addition, the landscape systems must be "acoustical." That means many "wall" panels must contain a substructure of fiber glass or other mineral fiber. Some panels must be fabric covered as well. The panels must not vibrate as they are used. (Desk top machinery is a special problem.) The connections between the panels must be as air tight as possible to isolate noise. The door openings must be varied so they do not act as funnels allowing noise to travel from one location to another. The panels must be placed correctly in regard to the overhead lighting fixtures.

BRAND SELECTION

The list of priorities essential when purchasing systems furniture includes (not in priority order -- to be evaluated by each individual company).

quality of manufacture

quality of materials

quality of design

depth of manufacturer's line

ease of installation, maintenance, rearrangement and demounting

number of space saving arrangements

wire management

task/ambient lighting

acoustical abilities

aesthetics

safety

availability (time required to receive orders and ship to site)

manufacturer's committment (warrantees, guarantees and service)

price

Whenever possible, a "checklist" for comparison from one manufacturer to another should be prepared. Next a survey of variable sales conditions should be made, including:

design assistance

user orientation (training or education)

installation arrangements

purchase documentation assistance (in some cases not necessary)

delivery times and schedules

Visits to manufacturers' showrooms should be made and a price list must be provided. The cost of each item must be multiplied by its occurrence and a percentage must be discounted for shared panels. Quoted prices for delivery, installation and other costs should be added to achieve a total price in order to compare one manufacturer to another. A limited or shorter list of systems furniture manufacturers can then be created.

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For all pieces which are to be purchased in especially large lots, samples should be provided by the manufacturers for examination in vivo for a reasonable period of time. Wherever feasible, visits to the factories of the various manufacturers should be made.

After a process which eliminates brands, manufacturers or their dealers or suppliers should be asked to submit quotes. They should also be asked to submit typical plans and elevations along with itemized lists of components and prices. For the receipt of quotes, allow a minimum of two weeks for small projects and a month for larger ones. All quotes from manufacturers or their suppliers or dealers must be made in writing.

All offers should then be reviewed. Selection or rejection should be made on the same basis. For example, the cost of 48" high panels cannot be compared to the cost of 64" high panels. All final trade-off decisions should be made between performance guidelines, price, service and specific technical features. Selections should always be made for the best overall quotations including features.

WAREHOUSING

Some corporations may find it exceedingly profitable to purchase systems furniture in large lots and store them on an on-going basis as facilities are remodeled or constructed. The ware-

house can store either spare parts, furniture and equipment set aside for replacement purposes or brand new items that cannot go onto construction sites. It is essential to note that there are difficulties involved in storing large scale lots of new items for long periods of time. In this era of rapid inflation it appears cost effective to purchase and store, removing furnishings on an as-needed basis. Buying everything at one time reduces the immediate price per unit. Besides, inflation will force prices of certain units -- especially those made out of wood -- substantially higher in the foreseeable future.

Unfortunately, manufacturers' warrantees and guarantees usually begin at the time of delivery. (Most warrantees run no longer than five years.) Units may in fact be in storage while warrantees and guarantees lapse. Units that are retrieved from the warehouse damaged, without certain parts, or in a general state of disrepair, may have to be discarded. Then, too, the cost of insurance and the possibilities of pilferage may cause certain items to be more expensive in the long run than originally imagined. For these reasons, it appears cost effective to enter into contracts with manufacturers or their suppliers or dealers to purchase systems furniture in large scale (if large scale projects are on their way), but to take staged delivery over a period of years. Vendors may require escalation clauses tied to delivery dates to protect themselves against inflation, but because the corporation is ordering in large scale, the best possible prices will still be obtained. Such courses of action must be evaluated during negotiations with the various vendors.

LIGHTING AND POWER

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Lighting the office

For an office area the best light is that which is well diffused, scattered evenly about. Too much light concentrated in any one direction causes shadowing and deep contrasts...which can be fine if one wishes to highlight special displays, but annoying if one wishes to read. The task area (the printed page, for example) should not be more than 3 times the lighting level of the desk or 5 times the lighting level of the surrounding area (Yes, reading in a small area of light in an otherwise dark room is bad for you; it causes eye strain).

Light shining directly in the line of sight is very annoying as well. That's why so much money has been spent by the industry designing fixtures that recess so as to hide the bulbs. But one must beware, the deeper the light is recessed into the fixture and thence into the ceiling the less effective the light will be. Except for certain especially designed luminaires, deeply recessed fixtures tend to broadcast far less light than surface mounted fixtures. The light is absorbed by the ceiling, the fixture surfaces and the bottom panels (Often as much as 40-50% of the light is absorbed)

It should be noted here that paradoxically, the smaller the room the more light is needed. That is because the light is closer to the wall surfaces and more likely to be absorbed than in a larger room. Then too, in a larger room, each lighting fixture tends to support the other fixtures.

The lighter the room and furnishings are colored, the more light there will be. Although the Illuminating Engineering society suggests using equipment and furnishings in medium tones, more and more offices are installing matte white or light finished desks, files and bookcases. Lighting levels can then be lowered and energy related operating expenses saved. (Glossy surfaces should be avoided).

The best light is that which is positioned so that it comes over the

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reader's shoulder. In this manner not only the direct glare of the shining light avoided, but also the indirect glare of the light which hits the page. At this angle that light bounces away from the reader, rather than toward him/her.

Indirect glare can be as annoying as direct glare. If the angle of light is such, the light bouncing from the page will shine directly into the eye and make the print unable to be read. A veil seems to have been drawn across the eye." (That in a nutshell is why glossy surfaces should be avoided).

As mentioned before, most of the older facilities have lights that are mounted in regular patterns across the ceiling, either as recessed or surface mounted systems. The newer and more expensive facilities often feature varied lighting systems. Some of these systems have a combination of incandescent and flourescent lights, others flourescent and HID lights. (Incandescent lights, although essentially wasteful in energy consumation, are still considered best for lending a certain sparkle to certain accent areas... the reception desk, the display counters, etc.)

Today, in the lighting industry, lighting more than ever is considered part of the interior design. Although architects, designers and others of that ilk always have been aware that lighting can bring texture and depth to otherwise uninteresting spaces, others have now have joined their ranks. In the last 15 to 20 years, great care has been spent designing handsome and functional fixtures for the work-a-day world.

Because of the energy crunch, rather than delivering the same high illumination levels throughout offices, designers now varying the design. This is known as <u>lighting by events</u>, where only those areas of greatest interest and use are lit to high illumination levels.

Corridors, for example, do not need to be lit as intensely as desk areas. In corridors, low illumination levels can be positioned so as to form pools of light which will lead people along. The lower illumination levels will be restful to the eye, and perhaps lend mystery to an ordinary walkway.

In the office areas, the lighting levels can be raised. For instance, whereas the corridor may have a lighting level of only 20 foot candles, the general office area may be lit to a level of 30-70 foot candles. Each desk may be outfitted with a desk lamp to provide 150 foot candles of light.

Indeed workers do seem to like this type of lighting if for no other reason that it helps to form territorial spaces. By illuminating a desk area and dropping the lighting levels in the spaces nearby, a sense of privacy is given to a worker...even though that sense may only be an illusion.

In tandem with this type of lighting design, a new phenomena has found its way into the office lighting industry: lighting that has been built into the furnishings.

Most manufacturers selling modular office furnishings offer this feature. The over all ambient light levels come from up lights provided by HID sources shining onto the ceiling. The ceiling acts as a secondary light source broadcasting the light all over the space. (This, by the way, means that the ceiling must have a white or off white coloration. Otherwise the space will be strongly colored by the hue of the paint on the ceiling). Task and desk areas are lit by individual flourescent lamps. Walls are washed by ceiling hung incandescents.

By using such a technique one can effect an operating cost of 1.6 watts/square foot (because the HID lights have a very low watt/square foot ratio. In older office facilities where the lights are placed row by row upon the ceiling

without regard to task, 4 to 5 watts/square foot are not uncommon.

Lighting is one subject in which there are no hard and fast rules. The amount of light a person prefers appears to be very subjective. And indeed, unless contested against each other, few workers can tell whether one office area is lit to a level of 50 candles or 55 foot candles.

Then too, the reason so many office buildings were erected with window walls had not only to do with the design, but supposedly with the amount of natural light that could be utilized by the workers. However, again and again employers have found that workers are wont to pull the blinds if they can. That is because the quality of daylight is not constant and any one concentrating for long periods of time has difficulty reading under day light conditions. Daylight should be used judiciously, and sunlight should be welcomed into office areas in those spaces where relaxation or traffic movements are encouraged.

Finally, we must note here that the handicap that is the most widespread in our society, is the one relating to our eyes. As a person grows older than 35 his/her eyes begin to age and many eye problems result that were not apparent before. Over the age of 66, 100% of the population has difficulties of one sort or another. For example, older workers are very susceptible to glare, contrasts and shadowing. In addition, older workers need higher light intensities because their lenses begin to thicken and discolor. The older the worker, the more the person requires a higher light level that is well diffused. (As any observer will note younger workers, just out of their teens, often do not seem to mind what type of light they work under).

Thec Technical Aspects

Unfortunatel y, lighting i/ a highly technical subject. To understand good office lighting techniques one should have a comprehension of electrical design, engineering aspects, and even physiological problems vis a vis the eye.

We have tried to make the discussion of office lighting clear, but to go any further and have the participants of this workshop be able to deal with lighting consultants, architects, engineers, or interior designers, they must be able to define certain terms. The next several pages contain a quick set of definition on the most common technical aspects of lighting with which our workshop participants will have to contend.

The Light Bulbs

Although light bulb is the common name, in the industry it is not in general use. All light sources are not bulbular in shape..flourescents, for example are tubular. Therefore, most lighting people refer to such equipment as "lamps" or the light source. However, for clarity, we shall continue to use the common name in the material to follow.

Light bulbs come in all sorts of shapes, sizes and colors, but their method for producing light can be divided into three main categories:

1. The incandescents...which product light by electrically heating high resistance filaments to a "white heat" till they glow. These light bulbs are not favored for corporate systems, although they are the most popular for household use. The reason? Well, fully 90% of the electrical energy consumed by the incandescent light bulb is radiated out in the form of heat. They are very inefficient, and particularly for a corporate facility, would tend to be an extremely heavy load on the ventilating air conditioning system. For household use they are preferred, first because of their color (a yellow-orange light, rather flattering to most skin tones), secondly because they are cheap to buy, and thirdly because they do not need any special ballasting. They can be fitted into any standard incandescent socket.

2. The flourescents...that produce light by establishing an electrical arc. The arc is established between two electrodes in a low pressure tube with a resulting discharge that excites crystals of phosphor coated on the interior of the tube, which in turn flouresces and produces light. Flourescents are the most commonly found light systems in offices. They provide at least three times the light per watt, any where from 11 times to 16 times the lamp life, low brightness and better diffusion than the incandescent. However, they do require special ballasting. One flourescent light bulb doesn't necessarily fit into the next flourescent light bulb's

fixture, They have an annoying habit of flickering as they burn out. Then too, many people do not consider their color to be as flattering as that of the incandescent, although much improvement has been made and flourescents of warm white and deluxe warm white tones are available widely on the market today. Finally, unlike incandescents, many flourescent must burn more than 3 hours a day or their r ated average life spans will be considerably shortened.

3. The High Intensity Discharge (HID) bulb....that produces light by establishing an arc, similar to that of the flourescent, but in a tiny sealed translucent or transparent tube under high pressure housed within a larger outer bulb. The r esulting high heat and pressure vaporizes atoms of metalic elements which emit electromagnetic energy in the visible range. There are three types of HID bulbs: the mercurys (whose lumens/watt fall somewhere between the incandescent and flourescent, and is generally used as a replacement for the incandescent), the metal halide and high pressure sodium (whose lumens/watt are much more efficient that that of the flourescent). Most HID bulbs, with the exception of the self ballasted mercurys require special ballasts and therefore special installation. They are not interchangeable one type with another. Then too, some HID's must burn as long as 10 hours/start or their average life span will be shortened (because of their high lumen/watt ratios and their generally long lives...some as long as 24,000 hours, they are exceptionally good where low maintence and good light is required). Finally, HID's do not have the best color rendition, although improvements have been made. In many office complexes they are used in conjunction with flourescent systems....because of this coloration problem.

The ballasts

Ir the above discussion, mention was made of ballasts. Incandescent light bulbs do not need to be ballasted while flourescents and HID's do. A ballast simply regulates the electrical energy flowing into the bulb. Without a ballast the electrical arc would increase beyond the ability of the bulb to function.

In addition, Class P ballasts have a fire safety measure as required by the National Electrical Code Section 410-71. These protected ballasts will work at temperatures exceeding 110°C. As required by the Underwriters Labs such ballasts are equipped with resetting thermal protectors, which once cooled to safer temperatures, will resume operation.

The Average rated life

Both the ballasts and light bulbs they service have average rated life span. An ordinary 100 watt incandescent light bulb will operate an average of 750 hours, a flourescent F40 lamp (the most commonly used), will operate an average of 20,000 hours, while some HID's will operate as long as an average of 24,000 hours. Most ballasts will operate an average of 12 years.

At the end of an average rated life span half of the bulbs or ballasts will still be working. For example, if a ballast has an average rated life of 12 years some where in the sixth year the first ballast will cease operation. By the 11th year, half will have burnt out. Management procedures have shown that in the case of both the bulbs and the ballasts it is best to group relamp or reballast when 14% have burnt out...that is, in one fell swope all the bulbs and/or ballasts are changed. The more ordinary procedure of spot relamping or reballasting is wasteful in terms of time spent in maintenance procdures and/or costs.

MEASURING LIGHT

There are several ways to measure light, and certain terms that must be understood before one can determine those measurements:

Watts - are a measurement of electrical energy. 1 watt = 1/746 horsepower. A 75 watt bulb draws 75 watts of electrical energy. The electrical utilities rates are based on a kilowatt basis (1 kilowatt = 1,000 watts).

Lumens - are the measurement of the volume of light emitted by a light source, be it a light bulb, lamp, etc. Many people confuse the lumens with the watts, probably because the ordinary 75 watt household incandescent light bulbs seems to give off the same amount of light every time. However, watts and lumens do not have any relationship to each other, except that together they will explain how costly the operation may be. For example a cool white flourescent may need only 40 watts to achieve 2960 lumens, whereas a frosted incandescent may require 150 watts to achieve the same thing. At .03¢ a kilowatt hour, one can see that the flourescent is much cheaper to operate.

Foot candles measure raw room lighting levels, in other words how much light there is without taking into consideration the ability to see beyond the glare, shadowing, contrasts, etc. A standard foot candle is equal to the amount of light produced by a plumber's candle at a distance of 1 foot. 30 foot candles is considered adequate light for most reception areas.

Reflection-Absorption

One must realize that a glossy surface will reflect more light than a surface with a matte finish. Lighter surfaces also reflect more light than darker surfaces. The Illuminating Engineering Society suggests the following for various surface finishes:

Surface	Reflectance	
Ceiling finishes	80-90%	(generally white)
Walls	40-60%	(perhaps light buff)
Furniture	25-45%	(perhaps light green)
Office machines & equipment	25-45%	(perhaps light green)
Floors	20-40%	(perhaps dark green)

Many interior designers, architects, lighting consultants and others of that ilk do not follow these reflectance suggestions. They consider the resulting design to be too institutional. Furthermore, in recent years, energy considerations have caused walls and furnishings to become lighter, as the lighter surfaces aid in the dissemination of the office lighting. However, except in certain areas, in most office complexes, glossy surfaces are avoided.

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ivalent Sphere of Illumination is a method of measuring room lighting levels that take into consideration foot candles, indirect and direct glare, reflection, absorption, shadowing, contrast, etc. It requires complicated mathematical procedures although an ESI meter may be on the market next year. However, given the spacing of the fixtures, the size and coloration of the room and furnishings, lighting manufacturers can provide a computer program explaining the ESI for various parts of the office facility.

One must take care, however, because ESI figures and foot candle measurements are not interchangeable. For example, in the following table most people would find a foot designation much too high (figures supplied by the Illumination Engineering Society).

Area	ESI
Drafting rooms	150-200
Accounting Rooms	150
General offices	150
Reading handwriting on ink on medium paper on good quality paper, intermittent filing	70
Private offices	70-150
Conferring and interviewing	30
Corridors	20

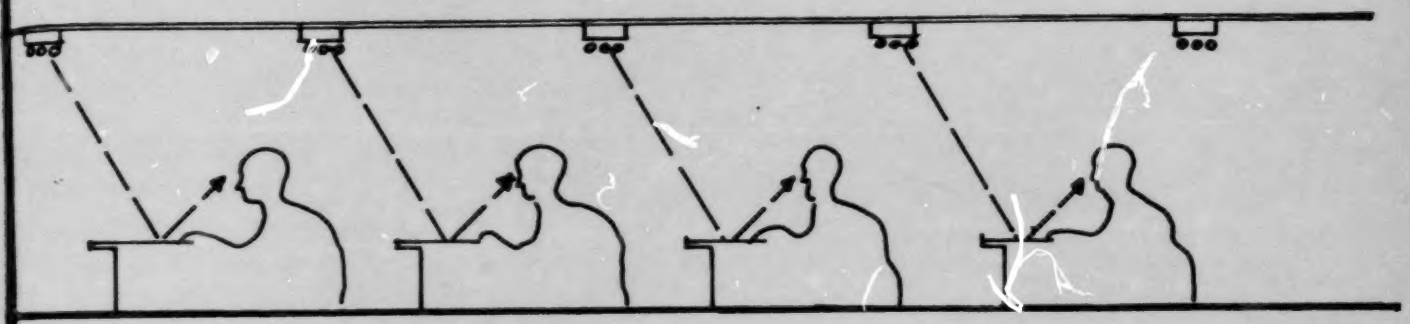
As one can see, for conferring and interviewing the Illuminating Engineering Society recommends an ESI of only 30. For office work, they recommend an ESI of 150. The difference can be accomodated by desk lamps. Overall lighting for the office areas can range between 30 and 70 ESI and additional light can be provided for desks by lamps.

One consulting firm suggests the following foot candle designations for offices:

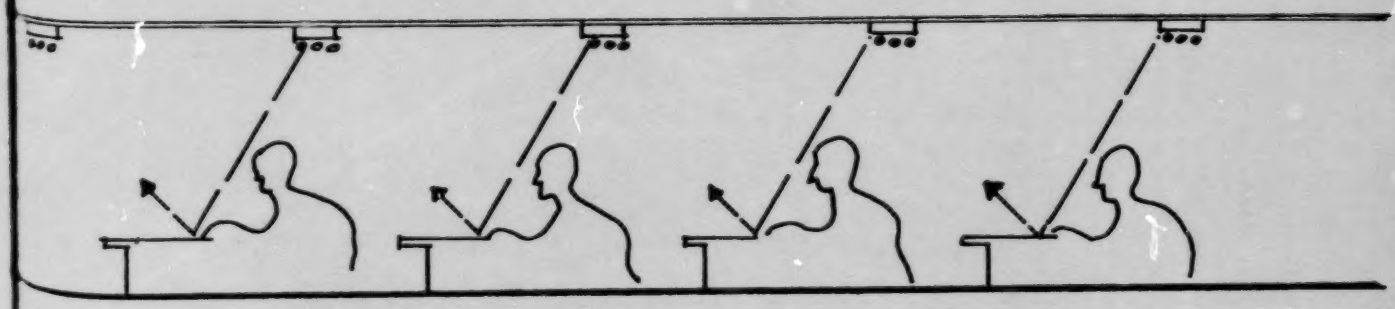
Task Condition	Foot Candles	Type of Illumination
Small detail, low contrast, prolonged periods, high speed, extreme accuracy	100	General lighting and supplementary lighting (desk lamps)
Small detail, fair contrast close work, speed not essential	50-100	General lighting and desk lamps
Normal office work	20-50	Ceiling fixtures directly over head (desk lamps may be necessary for some workers)
Recreational areas (tasks are not prolonged)...cafeterias, lounges, etc.	10-20	General Lighting
Seeing not confined, contrast good, objects fairly large... corridors	5-10	General Lighting
Visibility for moving about, handling large objects... large object storage	2-5	General or supplementary lighting

Visual Comfort Probability Index describes the comfort of lighting fixtures...or luminaires as they are called in the industry. Many fixture manufacturers publish VCP tables for their luminaires. A VCP of 70 or better is considered rather good. What that means is that 70 out of 100 people are comfortable in the light broadcast by a particular fixture. With a high visual performance fixture, 90 out of 100 people will be comfortable; the VCP rating would be 90.

REFLECTION AND GLARE

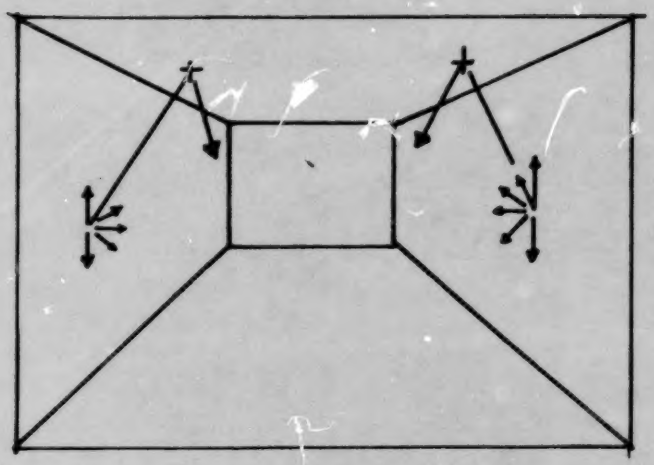


Bad condition - indirect glare toward eyes. Avoid reflective surfaces, use matte finishes.

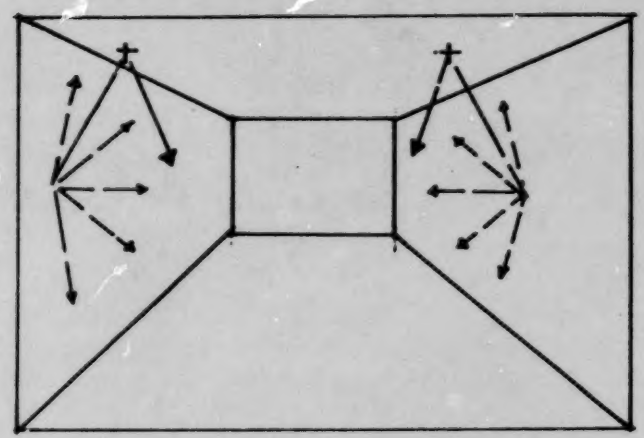


Good condition - light bounces away from eyes. Use light color matte finishes to help conserve energy.

LIGHTING



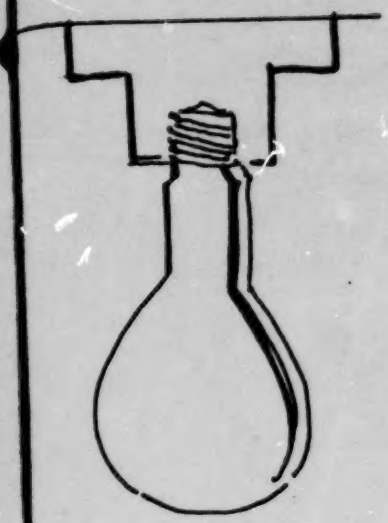
Low reflectance room surfaces, dark colors on walls lowers the apparent lighting level.



High reflectance room surfaces, light colors heightens the apparent lighting level...may glare unless light is diffused.

Color of ceiling and paper walls will give a decided tint to the light. (For example, a red ceiling will make light appear red.)

LIGHTING



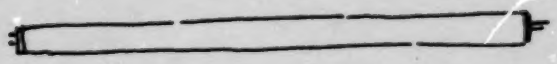
Incandescent

150 watts, 2700 lumens
brightness approx. 250 ft. candles/sq. in.

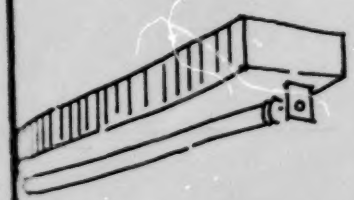
Advantages:
- dimming
- good color
- cheap
- optical control (accent lighting)

Disadvantages
- short life
- expensive to operate
- 90% of electricity discharged as heat

Flourescent



40 watts, 2650 lumens
brightness approx 5 ft. candles/sq. in.



Advantages:
- long life
- higher efficiency than incandescent
- higher lumens/watt than incandescent
- more diffused light at the source

Disadvantages:
- Must be ballasted - special ballast requirements for dimming and flashing
- Color is not attractive as incandescents

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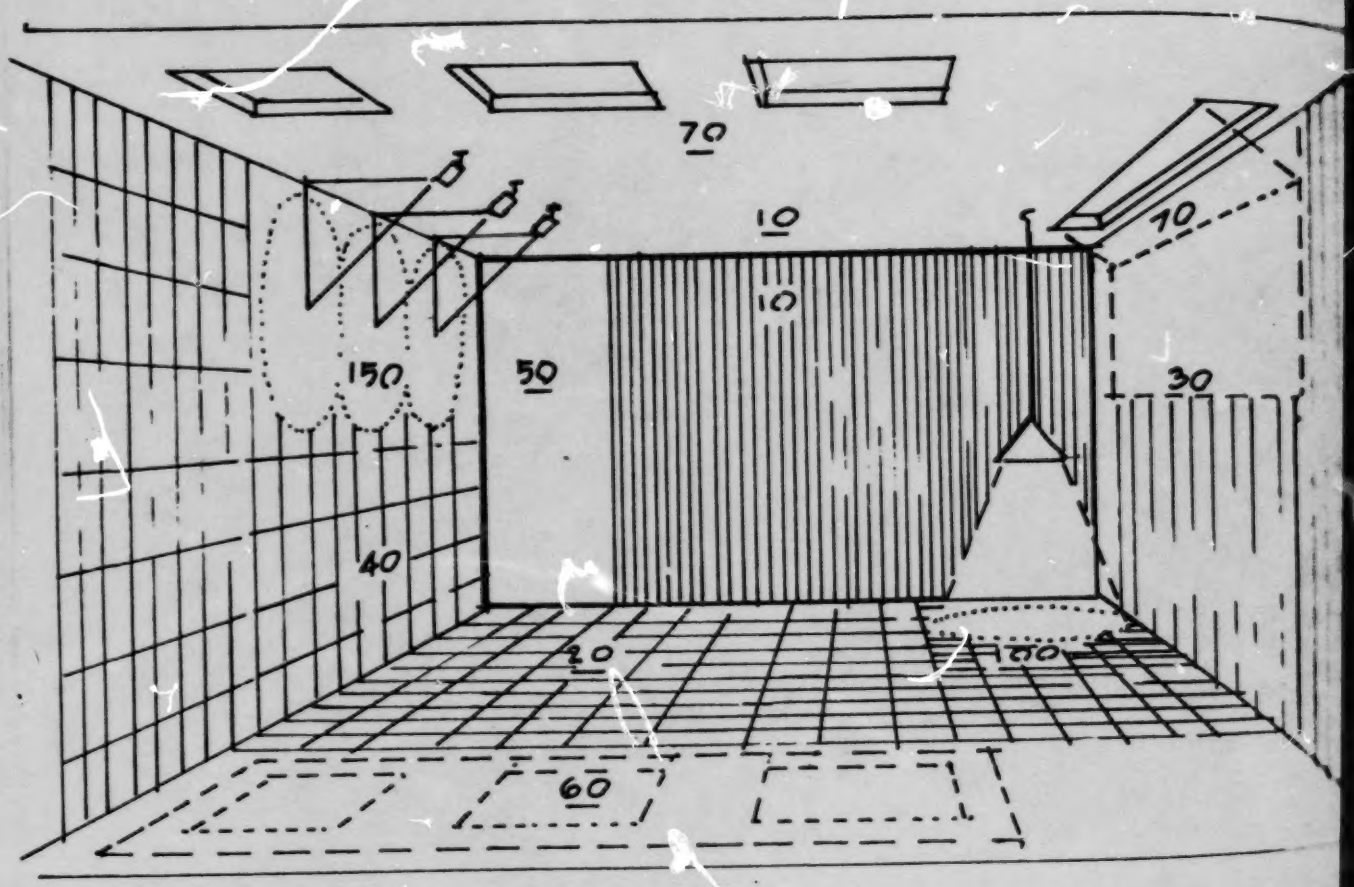
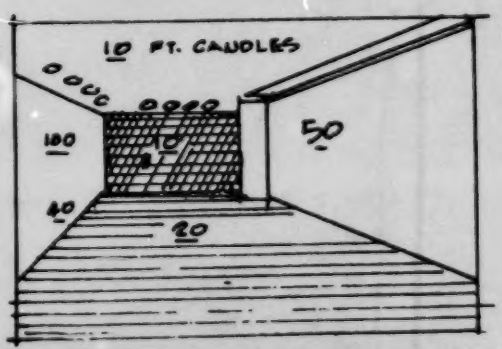


Light distribution in foot candles on walls, floors and ceiling.

The intensity and location of light will determine shape, character and mood of the space



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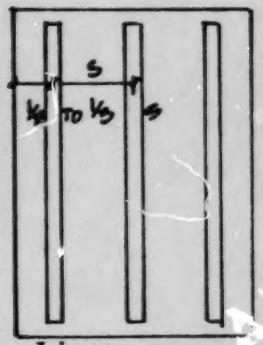
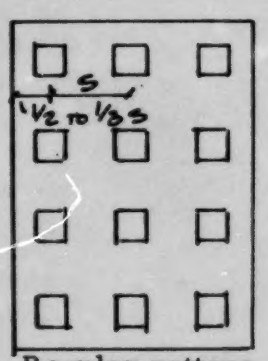
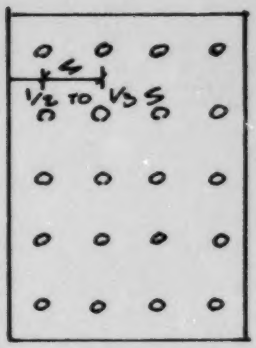
UNIFORM LIGHTING DISTRIBUTION



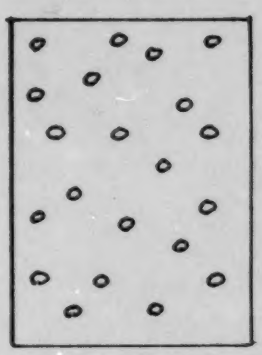
Linear arrangement
(flourescent)



Regular pattern
(flourescent)

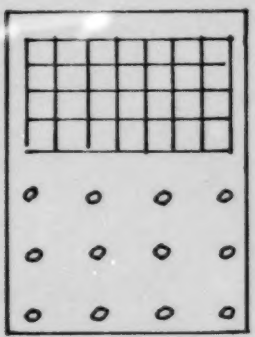


Regular pattern
(incandescent)

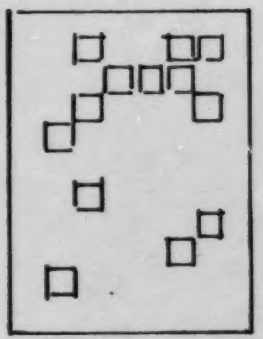


Random pattern
(incandescent)

NON UNIFORM LIGHTING DISTRIBUTION



Large area
panels



Fixture grouping

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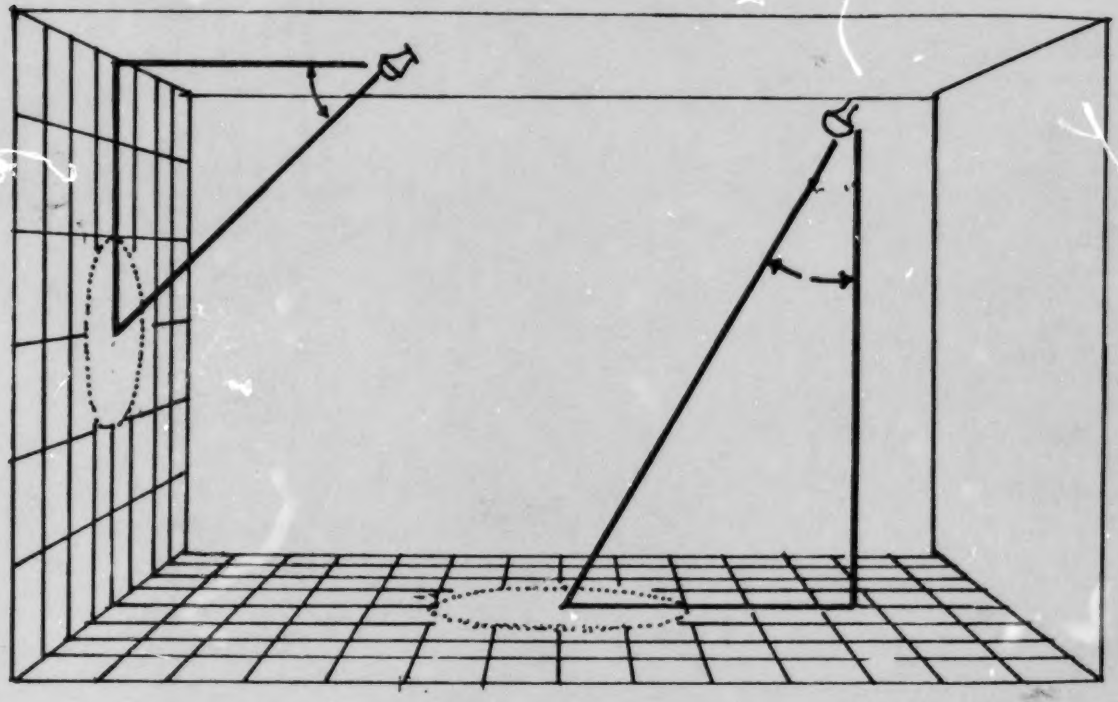
Aiming angle:
Vertical surface, wall wash

Aiming angle:
Horizontal surface, down



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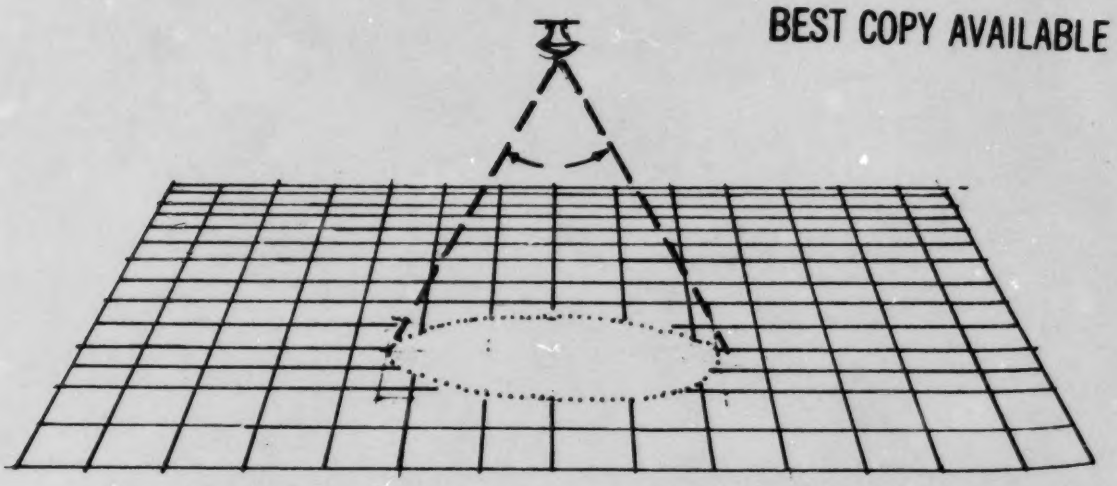

. Down light showing spread of light. Different lighting fixtures give different spreads of light

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light

Electrical/Telephone/Communications Power

Power can be delivered into an office complex via the walls, floor or ceiling of the building. In the older, large multistory office buildings so commonly found in the heart of our bigger cities, often the power supply is inadequate. Electrical, telephone and communications have become so necessary for ordinary daily tasks that a few wall receptacles spotted here and there will not do the job.

The Bell System considers that there should be a minimum of one telephone outlet for every 100 square feet of office space. Some electrical designers use this figure as well for the minimum office area for a private office is usually around 100 square feet. However, at one major corporation's headquarters, electrical, telephone and communications outlets were provided for every 24 square feet. Since that installation, over 1,000 outlet changes a year have been made, either activating previously unused locations or re-utilizing others. (By the way, most office spaces are in a constant state of flux. For example, the average telephone is moved 1.6 times a year, proving in our economy nothing remains stationary for very long).

In the newer office buildings, large scale power grids are embedded in the floor (or raised floor) and/or ceiling. The floor and/or ceiling surfaces are used rather than the walls, because in the newer buildings the walls tend to be temporary easily demountable structures. In other words, each floor is basically a loft supported by columns; the walls rarely if ever bear the weight of the floor above and therefore are not structurally important to the building.

Of course, outlets are provided on columns, but the columns are set at

a minimum of 20 foot bays, and often at 30 foot bays, one can see that supplying outlets at columns only would leave an office in short supply electrically. (In 20 foot bays, the square foot area is 400 sq. ft.; in 30 foot bays, 900 sq. ft.).

New power can be placed in the floor or ceiling via fixed conduit systems--the method we are most familiar--or modular systems. In the modular systems a raceway is in place and can be wired whenever a new outlet is required. In a single modular system the location of floor fixtures is available at any point along the cell run. Access is obtained by drilling a hole into the cell through the concrete or wood flooring. In a bi-modular system, floor fixture locations are predetermined by cell access fixtures located on the cell run of 4 to 6 feet.

Another system even more flexible is the Electrical Floor Assembly which brings power by employing metallic sheets, not wires, as conductors. These sheets are layered under the standard carpeting. Outlets are placed whenever and wherever they are needed. The conductors are easily located with a simple tool.

Since the ceiling does not need the strong construction of the floor, little weight is resting upon it, power grids are more easily accessible in the ceiling. It is far easier to reach wiring by pushing up a few ceiling tile, than drilling through the floor. In addition, when one abandons a floor receptacle and moves equipment, the resulting carpet or floor patch can be unsightly.

Ceiling systems have some of the same grid limitations that under floor systems impose. The National Electrical Code limits the use of metal conduit for electrical wiring in the ceiling to a 6 foot length, and a 5 foot length in the floor. For the ceiling this limits the service radius to 6 feet, for the floor, 5 feet.

In addition, the service must be brought down from the ceiling to the space where

it can be utilized (usually near the floor). This means that some type of "power pole"--simply a hollow pole bearing electrical/telephone/communication wires --must be employed. Many people object to the power pole idea, claiming that they lend an unslightly look to a space. However, many of the modular furnishings manufacturers offer power poles in tandem with prewired office furnishings.

By wiring the office furnishings for electrical/telephone/communications equipment, many of the unsightly wires can be completely eliminated. The power pole is integrated into a system where desks, for example, contain the wiring for all the power needs of the worker. The base of the desk may even conceal a junction box. Some power poles are built into the wall partitions, planters, and floor lamps. However, it must be noted here that these furnishings tend to be very expensive, although it is said that they cut down on maintence costs and so help to pay for themselves over a period of time.

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ACOUSTICS

A C O U S T I C S

In any office environment, intrusive speech is the major source of acoustical distraction. The high pitched whine of machinery, the constant clatter of equipment, and the incessant movement of people walking about may be annoying in some cases, but the single most common distraction is intelligible conversation particularly when one wishes to concentrate.

In an open plan arrangement, speech privacy between two workstations is often desired, but not as often received. Here the level of the background noise -- or ambient sound level -- that masks conversation is just as important as the acoustical qualities of the partitions dividing two workstations. What seems to matter most is the loudness of the intruding voice as compared to the loudness of the background noise. For instance, a person may not be aware of a conversation right next door once the HVAC system is in full operation. The constant whir of the ventilating fan masks the sound of the intruding voices. This relationship may be illustrated by the following formula:

Acoustical Privacy=Noise Reduction + Background Noise.

In other words, while speech privacy may be gained by increasing the absorbent qualities of the dividing partition by 5 decibels, a 5 decibel increase in the level of the background noise can also do the same thing.

Of course, there comes a time when the sound of the fan becomes too intrusive and becomes an annoyance in it's own right. That happens at about 50 decibels or the equivalent of a stage whisper.

If the masking sound is too high, people will raise their voices, defeating the purpose of the sound masking attempt.

It is for these reasons that "white sound" or "white noise" systems have become so popular. These electronic random noise generators, similar to radios, hide intermittent common office noises and, especially, human conversation. Human speech contains energy from 125 to 8,000 Hz. But certain frequencies contribute more to intelligibility than others. The component at 2,000 Hz. is more important than at 500 Hz. The "white sound" systems can be shaped to transmit more masking sound at 2,000 Hz. and do a better job at 40 decibels than a fan at 50 decibels. Therefore, the quieter "white sound" will not impinge upon the consciousness.

But there is a problem; most people do not like to think they are manipulated, even if that manipulation is only a "white sound system" to keep the office quieter. It smacks of "Big Brother". Researchers have found that when office workers are informed a white sound system is in operation, the noise it transmits suddenly becomes noticeable. If people are under the impression the noise is a normal by-product of machinery -- such as the heating, ventilating and air conditioning system -- they accept it and rarely pay attention to it.

In both enclosed and open plan office layouts, requirements for satisfactory speech privacy depends on five basic factors:

1. loudness of talker's voice,
2. acoustical character of talker's surroundings,
3. noise reduction between offices,

4. level of background noise at listener's position,

5. degree of privacy required.

In most cases, there is little that can be done about the loudness of the talker's voice. Some people naturally speak louder than others. No amount of "shushing" will make them quieter. If this is a problem, and all attempts to acoustically quiet the talker's office fail, then one or another of the workstation occupants should change location. (Here, one gets into personnel problems, a sticky difficulty at best.)

The acoustical character of the talker's and listener's surroundings is exceedingly important. So are the levels of noise isolation and reduction between the offices. Some materials are naturally sound absorbent. Usually these materials are soft, dense and honeycombed in nature. Fiberglass wool is commonly used as acoustical insulation in open landscape partitions.

The substructure of acoustical open landscape partitions is formed by an impervious central septum (to isolate sound) sandwiched between two sound absorptive layers. The whole thing is then covered with fabric. The absorptive layers are either a single permeable substance, such as fiberglass, or are constructed from a special combination of materials -- essentially porous or perforated outer layers leading to acoustical cells.

Although the panel covering is essential to good sound control, contrary to popular belief simply covering panel with any fabric doesn't turn it into an acoustical panel. Certain tight-weave

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fabrics and vinyls tend to reflect sound. And more open materials are not -- by themselves -- absorptive enough to control sound efficiently. Therefore, to assure absorption, the fabric must be "acoustically transparent" to allow the panel's inner structure to do the work. (Plastic laminates and veneers, by their very nature, reflect rather than absorb sound. Panels covered with such materials are not absorbent, although they may do a good job of isolating sound if they have the mass.)

As mentioned before, panel height affects sound control. So does panel width. A tall panel diffracts less sound than a short one, and the same relationship is true for wide and narrow panels. Obviously, there must be a balance between height and width. It would accomplish little to use a panel that is 8 feet high but only 5 feet wide. Sound would travel around the narrow panel. The panel must do a good job of wrapping around the task area.

Increasing panel height will not adequately compensate for a poor acoustical ceiling. An acoustical ceiling that absorbs at least 85% of the air borne sound is necessary -- the ceiling in an open plan (as in all office layouts) tends to be the major noise reflector. Ceiling-hung light weight fiberglass boards, 1½" to 2" thick, finished with a white texturized coating, suspended in a grid below the real ceiling does the very best job. These boards seem to absorb even more sound than the conventional mineral fiber tiles used in most installations. Acoustical baffles help to prevent the horizontal flow of sound across the flat ceiling and dampen sound. Acoustical coffered ceilings also do an even better

job. Here it is important to understand that the size and type of the ceiling-hung lighting fixtures are significant. Hard, flat plastic lenses reflect sound. The use of these fixtures causes open landscape offices to be especially noisy. The major approach is to replace flat fixtures with recessed or specially designed ones. Three types do the best job:

1. a parabolic aluminum baffled fixture,
2. a properly recessed V-lens fixture, and
3. a conventional 1½ x 4½ flat lens fixture in an ashlar pattern 10' on centers.

Tests have shown that gaps between or under panels significantly reduce their sound isolation qualities. Sound can easily find its way through holes. A 1 square inch hole will transmit more sound that 100 square inches of thin partition. (Sound can work it's way through most structures, depending upon the frequency and the decibel level. We are all familiar with sound traveling through partitions. For example, a complaint common to apartment dwellers is that one can hear what is happening in the apartment next door, through the wallboard. The thicker the wallboard, the less the transmission.) Therefore, if speech privacy or acoustical qualities are extremely important, panel connectors must be as tight as possible (light between two panels at their connections should not be visible) and the panels should run clear down to the floor.

Early acoustical panels and ceiling tiles were intended to absorb excess sound. They were evaluated in terms of the Noise Reduction

Coefficient. A panel with an NRC of .85 was said to absorb 85% of the sound striking it's surface. However, the only test the NRC was concerned with was the absorptive qualities of the panel. It did not measure the sound level on both sides. Thus, it could not determine how much sound passes through. While much of this transmitted sound may eventually be absorbed, it is the initial transmission that will destroy speech privacy.

A newer method is to test the Noise Isolation Class (NIC). The NIC provides an accurate rating of the degree to which a panel blocks sound transmission on both sides of the divider. In fact, the sole purpose of the NIC is to measure the sound transmission between workstations in an open landscape plan.

The federal government's General Services Administration has incorporated the NIC into a concise mathematical equation which describes the level of speech privacy in an office. This equation defines Speech Privacy Potential (SPP) as 60 for normal privacy and above 60 for confidential privacy. The SPP is the sum of the Noise Isolation Class and the Noise Criteria Rating (NC). If the NC can be viewed as a decibel rating of 40 (the background noise found best for an open plan office), then the equation reads as follows:

SPP=NIC + NC40

60=20 + 40

In other words, if open landscape panels are to be sufficiently acoustical, they should have a NIC of 20...where 23 is considered the NIC of the open sky.

Installation of noise absorptive, noise isolating panels, an acoustical ceiling, proper light fixtures and a masking sound system does not eliminate all the sound reflected in an open office. Permanent walls, windows and other vertical surfaces reflect sound and destroy speech privacy.

Reflections off permanent walls can be eliminated by hanging acoustical panels or some other form of acoustical insulation on the walls at the spots where reflections occur. At the very least, walls should be treated in this manner in the region between 2 feet and 6 feet from the floor (book shelves loosely packed with volumes make first rate sound insulators). Sound reflected from the walls below this region usually are diffused or absorbed by panels, carpeting and furniture. Sound reflected above the region will be absorbed by the ceiling. (It should be noted that ordinary drapes or carpeting hung on the wall will not absorb enough sound to prevent reflection between workstations. Such materials should be backed by mineral fiber or fiberglass boards.)

Square and round columns should also be paneled or treated with acoustical material. (Round columns less tha.. 1-½' in diameter need no treatment. They will diffuse sound.)

Reflection off windows is very difficult to eliminate. Most sound absorbers also impede vision. Draperies are effective absorbers if they are made from extremely heavy material and kept closed. On a nice sunny day, few employees want to keep the draperies drawn.

One way to avoid such an objectionable solution is to tilt the window glass out of the vertical plane toward the ceiling or the floor. This will allow the ceiling and floor to absorb most noises. However, this solution tends to be costly and difficult to implement. A more economical solution--and one that provides at least adequate results--is to use vertical louvers. Louvers will diffuse sound and not seriously impede light or vision.

Most office furniture tends to diffuse sound and, therefore, does not hamper good sound control. But long rows of metal files will reflect significant amounts of sound. Where files must be placed in long rows, their backs should be paneled or lined with accoustical materials.

Office layouts tend to be another factor in noise control. Here a major criteria is the degree of sound privacy required by the listener. Certain jobs require considerable concentration. Others do not. For example, accountants normally work together and do not need exceptional speech privacy. Financial analysts, on the other hand, write long detailed reports and require offices that are quiet. Their offices should be located out of the stream of things--perhaps on a quiet single access corridor where few employees pass by. Their offices should never be located near busy walkways, near word processing stations or areas where telephones are constantly being answered.

As far as the layout factor is concerned, the most important aspect is the spacing of the workstations. Regardless of how

highly the rating panels and ceilings will be ineffective if employees are located too close together. Speech privacy generally means that normal conversations cannot be understood in another workstation from seven to fifteen feet away. Thus, the distance between workers is a basic component of speech privacy. The solidly packed office in the old bull pen style is an unrealistic goal when using open landscape. In general, maintaining a distance of 8 to 10 feet between workstations should provide privacy from conversations and other major distractions if acoustical installations (as noted in this chapter) are taken into consideration. It is unrealistic to assume that conversations will not be heard if the talker is standing only 3 feet from the listener without totally enclosing walls.

Another layout factor affecting speecy privacy is workstation configuration. The shape of the workstation and the direction it is facing influence the manner in which sound enters or leaves. Sound travels in straight lines. So the line of sight is a good indicator of at least one path the sound will taken when a person speaks. Usually when two people can see each other, they can hear each other. Seeing another person's expressions, lip movements and gestures increase the intelligibility of what he is saying. Vision itself can help to destroy speech privacy.

Simply rearranging desks, then, goes a long way in affording speech Privacy. People that face away from one another, do not hear each Other as well. Staggering workstations eliminates the direct sound Path between workstations. Components should be arranged so that

when an employee is in his or her own workstation, speech is directed inside the station, rather than right out the opening. Also, conversational distances within workstations between employee and guest should be kept short, between 3 and 6 feet, so that people do not have to raise their voices to be heard.

Several areas of the office environment require special sound control treatment. Areas such as word processing centers should be located near services cores (elevators/stairwells/toilets/ mechanical rooms). By locating other sound intensive areas near these cores, the noisy distractions will be centralized and thus more easily controlled. In all situations, attempts should not be made to sandwich office areas that need quiet between noise intensive ones.

Common sense also indicates that those departments generating the most traffic, and therefore the most noise, should be as close to the building's core as possible. One should not have to weave in and out of more quiet departments to get to heavily trafficked areas.

Machinery and equipment often add to the office's noise problems. The very worst sound seems to be a high screech emenating from the ventilation system. This usually means that something is out of whack and must be fixed or at least oiled. Wherever possible, heavy machinery attached to the building's structure should be suspended on resilient mounts and located as close as possible to structural columns to minimize floor vibrations. In addition, to avoid vibrations that cause furniture to vibrate, wherever large

pieces of equipment are used it is best to avoid tables and desks that are not securely resting on at least four legs. To support any equipment that is especially troublesome, free standing tables or desks are best.

Acoustical pads and acoustical panels are available that will wrap under or around common office equipment. Typewriters, in particular, seem to give many pause, and they should be placed in workstations where acoustics have been taken into consideration.

The older offices relied upon tile floors rather than carpeted ones. Today, carpeting has been found to be as cost effective as tile -- most commercial carpeting needs only to be vacuumed. (Shampooing is a task done only once in a long while.) Commercial carpeting glued directly onto concrete tends to have a fairly low acoustical rating -- about 20 NRC. However, it considerably quiets the constant sound of walking traffic, something that tile does not do. With few minor exceptions, if for no other reason than good acoustics, most major offices are carpeted today.

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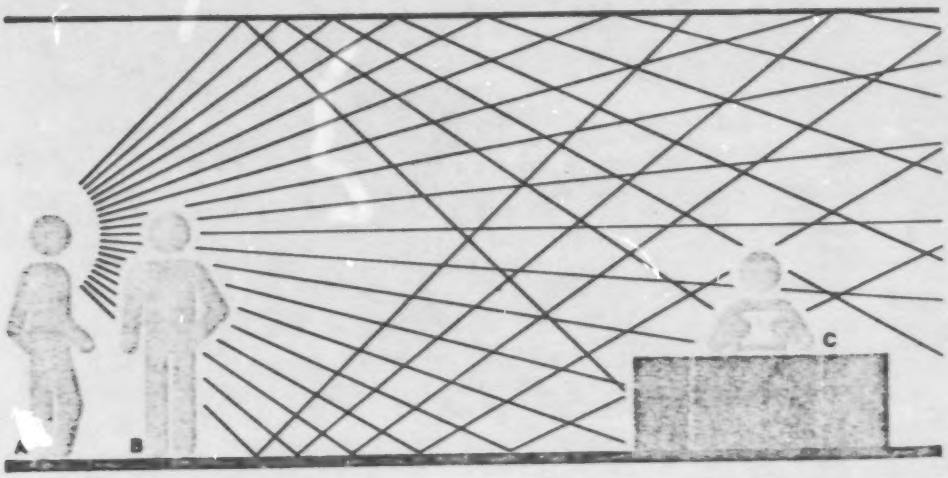

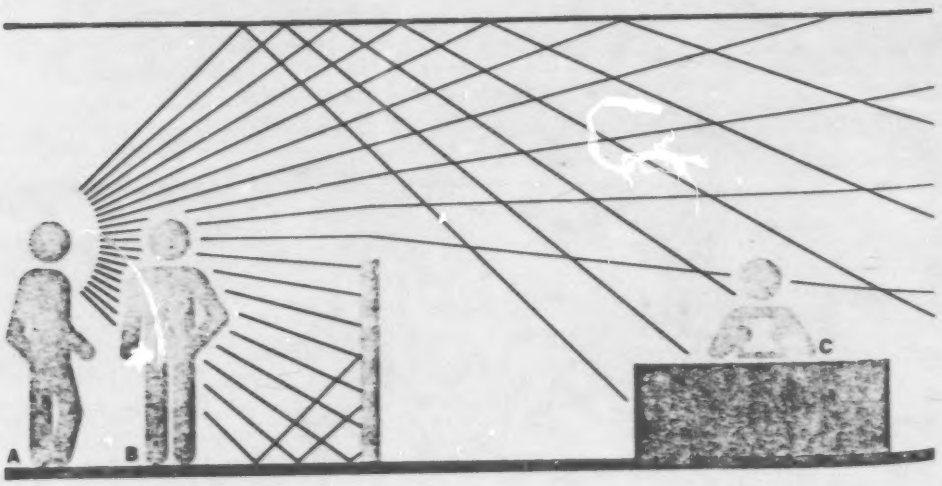

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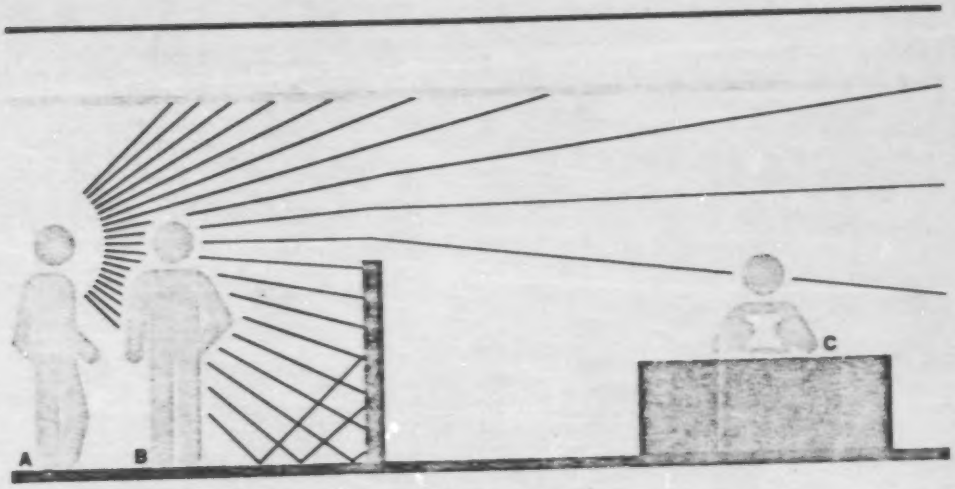

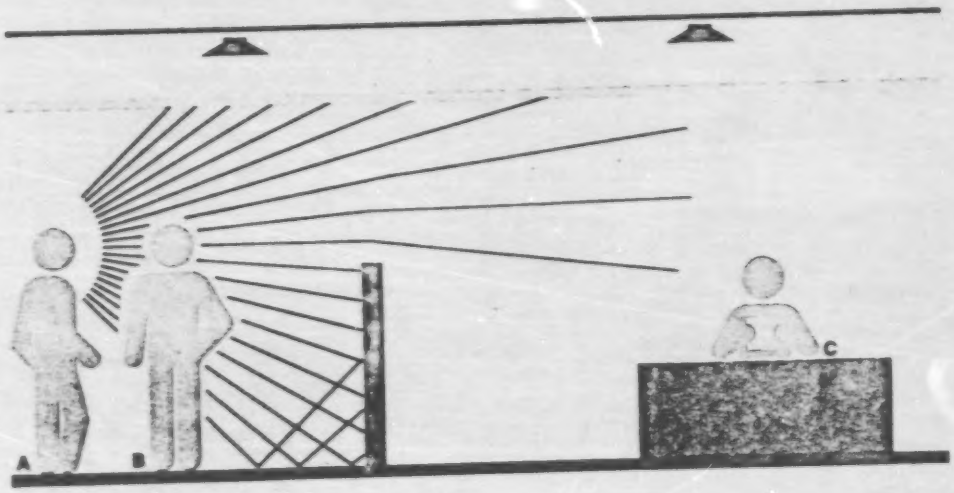

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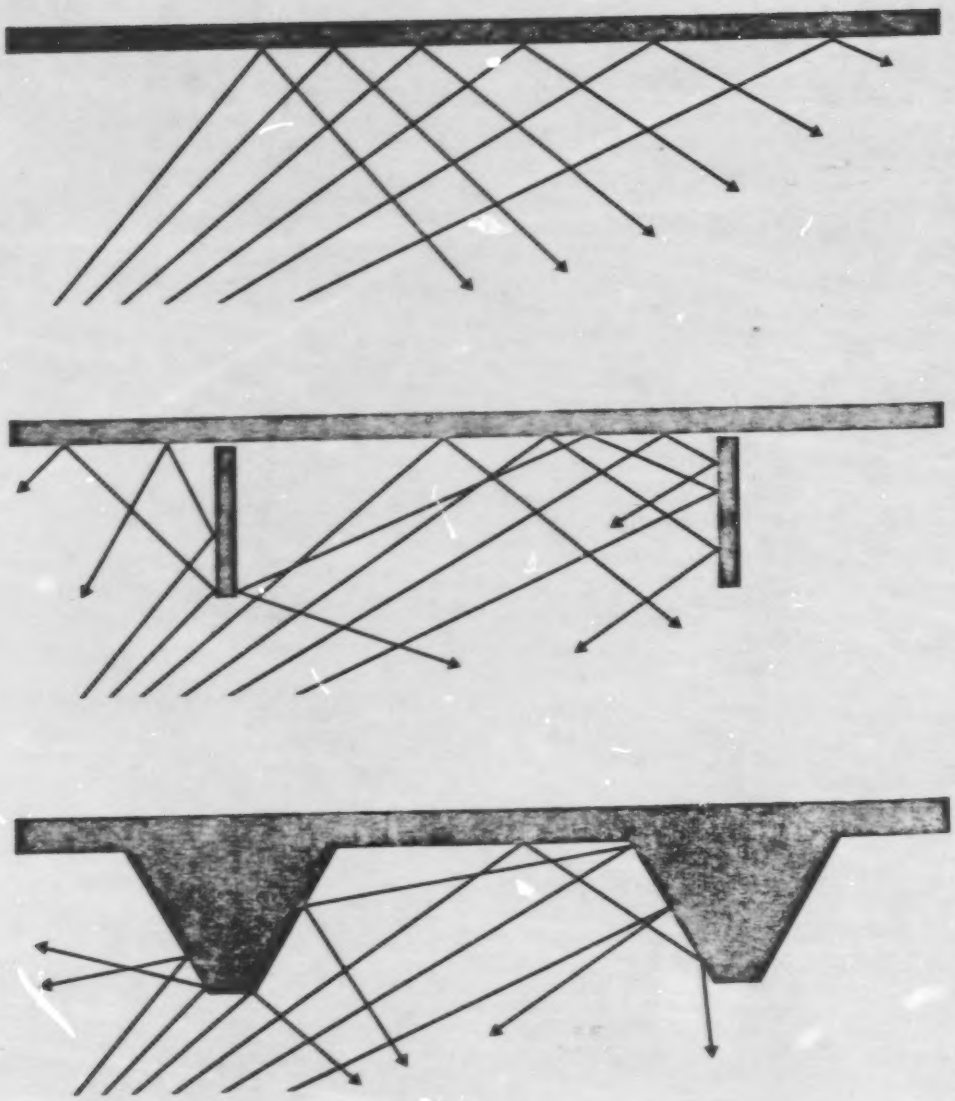

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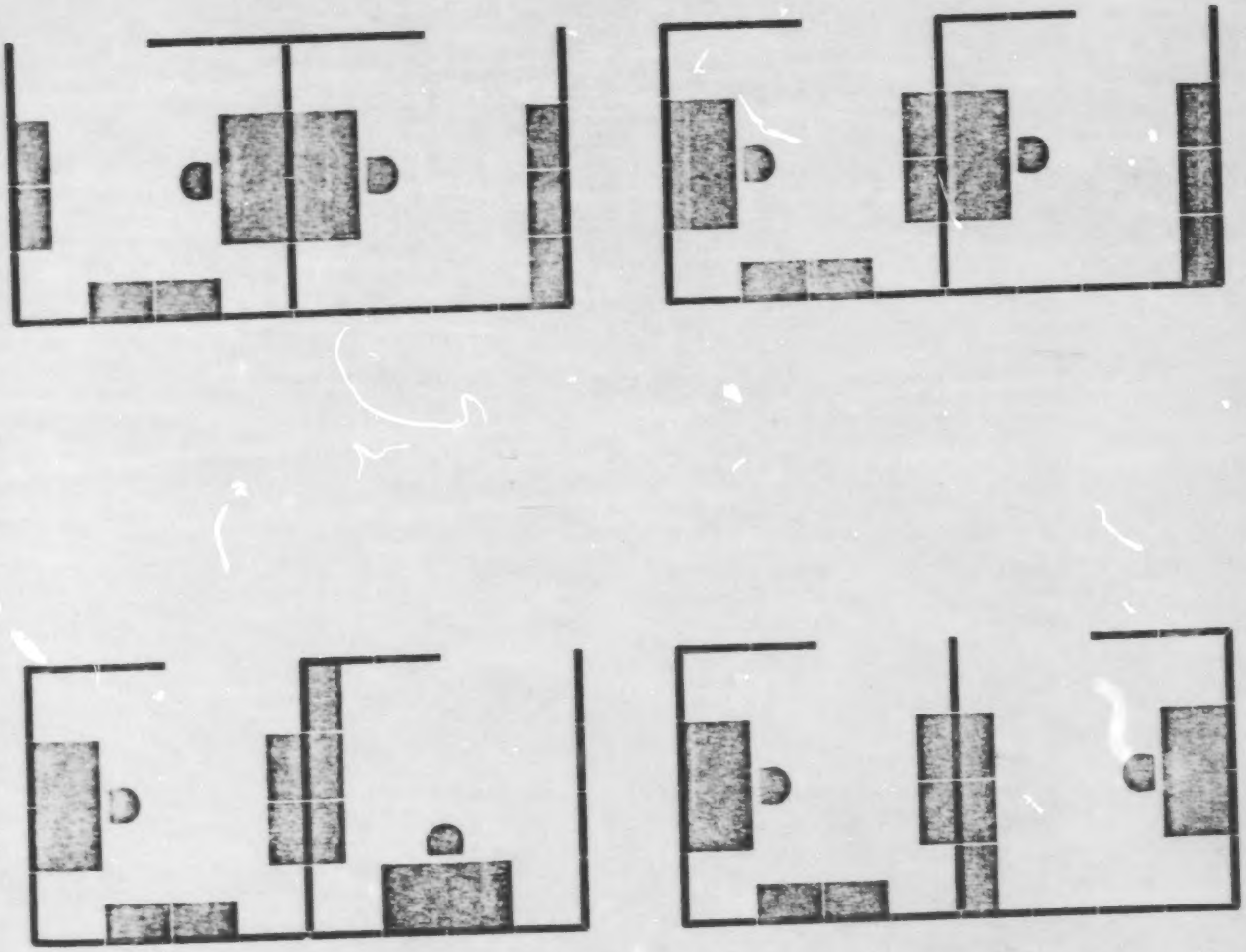

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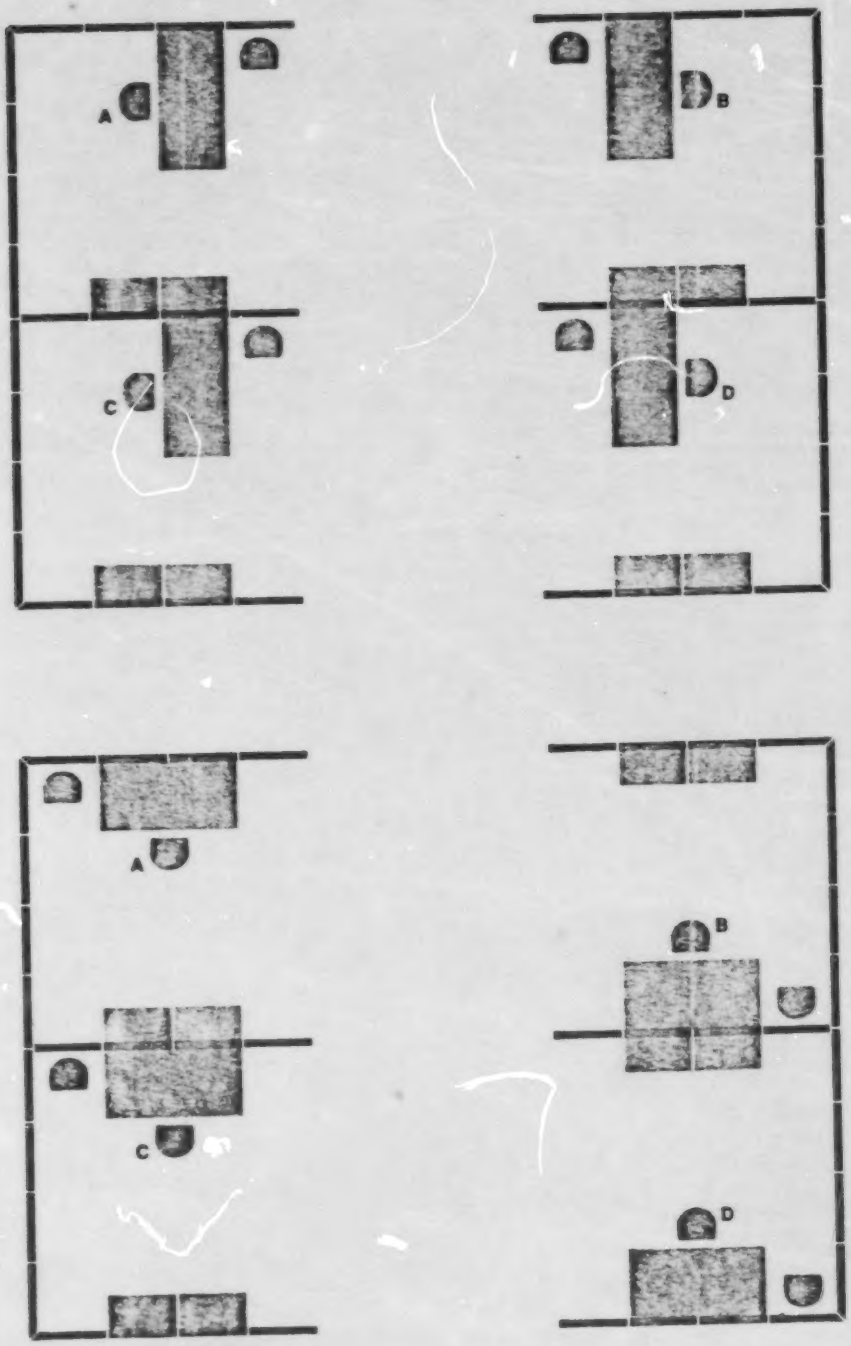

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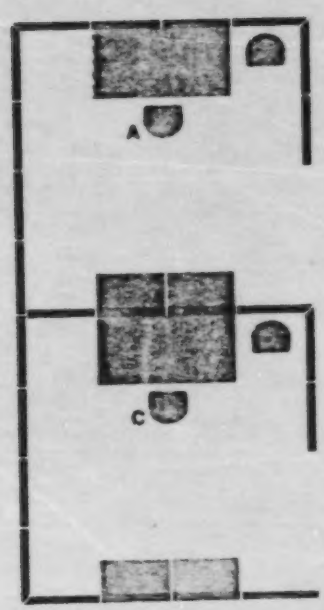

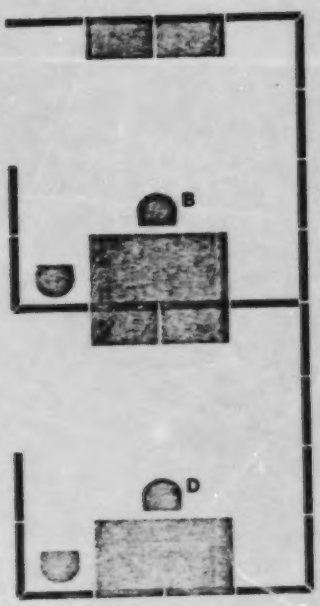

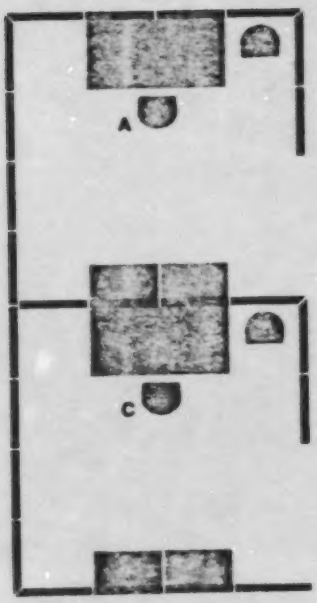

ENERGY

ENERGY

In November, 1973, the Arab nations rich in oil turned off the spigot and boycotted the United States. Several months later they resumed the oil flow, but quadrupled the price, beginning a new era in American history, an era in which a necessary commodity once considered cheap is fast becoming expensive. That commodity is energy.

It's taken a while for the facts to sink in. Many still refuse to change proliferate ways. Even now commercial and institutional buildings are being constructed with only the short term in mind, worrying about capital, upfront costs and leaving escalating prices of energy operation to the next administrations. Indeed, few buildings are being constructed that even take into consideration major climatic variations from one part of the nation to another. Even now there are buildings being erected all across the country resembling Californian residences, using glass as the major exterior component. Because glass is a poor insulator and because rarely do windows in glass buildings operate, many such facilities are forced to depend upon mechanical means to warm, cool or ventilate -- including those days when the outside temperatures remain within comfortable levels. One would think that this wholesale reliance on technology is a step forward, but surprisingly, too many new facilities are housed in buildings less comfortable than those replaced. Mechanical systems have a tendency to fail, especially when overwhelmed by climatic extremes.

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Building with the climate in mind is not a new idea; that would be akin to reinventing the wheel. Our forefathers designed for climatic extremes because it was necessary. One hundred years ago, air conditioning systems were unknown. Even fuel for heating purposes was difficult to procure in various parts of the nation. For that reason, indigenous designs often served as models for settlers. Indian pueblos in the southwest cleverly kept the morning and afternoon heat at bay in the summer, but were oriented in such a way that maximum sun was welcomed in the winter. Constructed of adobe -- a building material particularly suited to desert conditions where temperatures are apt to rise and fall 70° in a day -- the exterior materials of the pueblos restrained the heat of the brutal summer daytime sun but slowly absorbed the warmth to re-radiate it into interiors at night. The Seminole Indians, on the other hand, living not in the desert but in hot-humid climate raised large gable roofs well insulated with grass and built their villages in such a manner as to allow free air movement. This encouraged evaporation of humidity. This same idea was later translated, by plantation owners, into large homes, magnificent white edifices three stories high with wide windows shaded by stately verrandas. On the north east coast colonial architects also used wood -- a widely available building material which is also a first rate insulator -- to fashion much more economical houses, houses repeatedly copied today. In the coldest latitudes where freezing winds were quite common, the "colonials" borrowed into hillsides, exposing only one story to fierce northern exposures while on the southern orientation the entire facade was

exposed to the beneficient winter sun. (This idea has been appropriated and used by several corporations and institutions to construct "underground" facilities, the most famous being the Pusey Library at Harvard.)

These techniques were -- and are -- passive methods of energy conservation. The manner in which the sun's rays are welcomed or avoided does a major part of the job. Most passive systems depend upon the fact that in all parts of the continental USA, the sun rides high in the sky in the summer and at a much lower angle in the winter, allowing solar radiation to be avoided in the summer and captured in the winter. Even in this technological age, passive solar systems are possible and can cut energy usage from building to building extraordinarily. To design a passive system, one must take into account:

1. Site Selection - some building sites are better than others. Obviously if an area is plagued by freezing winds, the building should not be constructed on the highest hill.

2. Orientation - as indicated, certain facades are better than others. Too much glass facing due west in a hot climate overwhelms even the best air conditioning system, while too much glass facing due north in a cold climate forces the heating system to work harder and harder.

3. Building Shapes - exterior style influences interior comfort. A long rangy building is out of place in a northern climate because it offers too much surface to freezing winds. An "A"

frame construction is out of place in a southern desert because it collects the heat indoors and does not let it dissipate.

4. Building Materials - the insulation and even the color of exterior materials influence indoor temperatures. Single pane glass abutting a black asphalt parking lot and facing due south builds up heat in adjacent interior spaces.

The real specifics of a passive solar system are in the purview of the architect or engineer. However, the planner should be aware that such systems do exist and should expect the ultimate design of a new library building to take the climate into consideration, remembering that the best methods of building often are updated variations of indigenous older structures.

HUMIDITY

By the way, to understand energy conservation and for that matter, how some systems are expected to work, it is important to understand certain conditions that affect human comfort. We all know that relative humidity is very imporant, for example, and that during a good portion of the year the deserts of California tend to be more comfortable than the bayous of Louisiana. Actual temperatures in the two areas may be identical--at least during the day--but in a hot dry climate people feel more comfortable than in a hot humid climate. Body perspiration tends to evaporate in the former and not evaporate at all in the latter.

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On the other hand, a too dry climate is not beneficial either. In northern facilities, during the winter the indoor relative humidity can reach 0%-10%, causing the skin to dry and the membranes of the nose and throat to crack -- allowing places for harmful microbes to enter. Yes, that's one of the chief causes of the common cold! Spraying a fine mist of water into the air is a good way to raise the relative humidity and the comfort and health of the inhabitants as well. It also does a lot to dampen static electricity, a particular problem in office facilities depending upon automated systems.

Relative humidity depends upon the temperature. Warm air holds more water than cold air -- warm air is less dense and, therefore, has a larger volume capacity. That explains why it gets so dry indoors during the winter, cold air with, say 40% humidity is brought indoors and heated. The humidity level then drops precipitously. That also is why it rains when warm air meets cold air. The colder air cannot hold as much water as the warm and shakes the excess out of the sky.

As far as humidity is concerned, for the interior of a building, the relative humidity is best when it is about 50% with 30% to 65% being outer limits (although as previously noted, in northern climates it is not uncommon to find extremely low relative humidity in the winter time inside a facility.) For an office, it is best to keep the relative humidity as close to that 50% mark as possible. Above 60% mold starts to grow on certain papers while below 40% some papers -- particularly older documents -- tear from the

effects of shrinkage. Below 40% RH computer paper begins to pick up excess static electricity. In very dry conditions, the effect of static electricity on computer equipment can be devastating. Just someone passing by is enough to turn on the machinery or wipe out memory. In the case of microforms, below 30% RH film becomes brittle, while above 60% it becomes soft and sticky.

By the way, one must realize that humidity plays a role in keeping down static electricity. The colder it is, the more likely one is to pick up static electricity walking along the floor--even with anti-static agents in the carpeting. A higher relative humidity helps to keep that problem within manageable levels as humidity dissipates the electrical charge.

TEMPERATURE

In the United States, no matter what the Department of Energy says the temperature comfort zone ranges between 65° and 80° with the indoor average being somewhere between 72°-74°F. This is substantially different than most other nation's. The British, for example, have a comfort zone between 58° and 70° for winter (remember many homes in Great Britain do not have central heat), and a much higher one for summer. As a matter of fact, many office buildings in Europe are not air conditioned. The same is true of many public meeting places. A visit to a Parisian restaurant on a hot day can be a very trying experience for an American. The heat of the ovens along with the heat of the street makes the inside unbearable--but the Parisians don't seem to notice.

Obviously, then, differences in comfort zones are generally cultural. The British and the Germans expect to wear much warmer clothes indoors in the winter than their American counterparts. Such heavy textiles until recently were not sold on the American market because they were perceived as being too warm for indoor use even in the winter.

We mention this because since energy has become expensive and public buildings have dropped their temperatures to 65 ^{o}F, employees have taken to wearing a sweater or two along with warmer footwear. But most of these same people believe they are being ill used. They are wearing warmer clothes out of self defense, but they believe that the office and the government is going about energy conservation a little too wholeheartedly. Although they are constantly told for every 5^{o} reduction in temperature, an 8% reduction in fuel is effected, few care. Old habits are hard to beat.

MECHANICS OF TEMPERATURE TRANSMISSION

The mechanics of temperature transmission helps to understand energy conservation to a degree. Temperature changes are transmitted through three basic processes: radiation, convection or conduction.

RADIATION

Radiation works in a manner similar to light. As a matter of fact, most heat is only a variation of light, long waves as opposed to the shorter visible waves of the same electromagnetic energy. As

in the case of sunlight as long as one is somewhere within it's radius, one can feel that heat. Move away and the warmth will disappear. That explains why it is warmer in the sun--all things being equal--than in the shade. That also explains why someone standing in front of a blazing fire can still feel a chill on the back.

Building materials can absorb and then re-radiate the sun's heat. As mentioned, adobe can absorb solar heat and re-radiate into the interior space long after the sun has set. Cinder block, brick, and masonry walls can do the same thing. In certain geographical areas of this nation, that property is very beneficial. In other areas, it is not at all. For example, in a hot humid climate, one would not want the interior of the building to stay warm at night since outside temperatures do not cool down. Then too, in a cold climate, uninsulated masonry absorbs the heat manufactured by the heating system and eventually dissipates it out of doors, obviously not beneficial in the day and age of expensive fuel.

Radiation can be helped along by the color of the building material. Dark colored objects absorb heat while light colored objects reflect it. On many buildings in the sun-belt, reflective glass facades have been erected so that very little of the sun's radiation can make its way indoors. (By the way, that explains why we've been wearing dark colored clothes in the winter and light colored ones in the summer--to maximize the clothing's heat absorbing/heat reflecting effects.) Light colors in interior walls and ceilings help reflect heat back into office areas. In the

winter, reflective shade material facing toward the interior help reflect heat away from the windows and back into the buildings.

CONVECTION

Radiation in tandem with convection is one of the chief causes of wind on the earth's surface. Solar radiation warms pockets of air which then move upward, leaving space for cooler air to sweep in at lower levels. Remember: hot air rises, cold air falls. In an office, heat vents are placed near the floor while air conditioning vents are placed closer to the ceiling to take advantage of this natural movement of air. (In a forced air system, it's not uncommon to have ducts installed in a ceiling. Then the heated air must be pushed down to the floor by means of fans installed within those ducts.) There are times unwelcomed convection currents cause drafts when the heated air starts rising toward the ceiling and the cold air flows in along the floor. This is particularly the case in large open plan facilities, especially those designed with a myriad of atriums and mezzanines. Convection currents caused by the heating/ventilating/air conditioning systems (known as the HVAC) move unimpeded across the space and from one floor to another. In addition, infiltration of air through cracks around windows or entrance doors that remain open exacerbate the problem - especially on days when the air pressure outside is either much higher or lower than that inside the building. In other words, air of different temperatures is always flowing in or out.

depend heavily on HVAC ducts around the periphery to do the yoeman's job. In certain buildings, the furnace-connected heating ducts in existence run around the periphery. The core of the facility depends upon reused heat from operating machinery, lighting bulbs (and their ballasts) and the body temperature of the occupants.

To prevent air from seeping in or out of the building, obviously all windows and doors should be weatherstripped and, in the case of operating windows, form a tight seal when shut. Revolving doors do a first rate job of preventing air inflow/outflow and solve the sticking/blowing open entrance door problem. They do a much better job of keeping the interior draft free whereas the more popular treadle operated doors often stay open much too long during particularly busy times. Unfortunately, revolving doors are impossible for wheelchair users. Therefore, an alternate means of access for the handicapped is necessary.

CONDUCTION

The third method in which variations in temperature are transmitted is through conduction. Conduction is the process in which materials transmit changes by touch. We know, for instance, that a frying pan with a metal handle may be too hot after sitting on an open fire for any length of time and will burn the unprotected hand that touches it. The metal handle picks up heat from the rest of the pan and transmits it to the edge. A wooden handle on the other hand, insulates; it can be touched even after the pan becomes hot.

A similar situation takes place on the frame of a window. While metal frames do not rot and for that reason often are the preferred frame for commercial and institutional buildings, metal frames transmit outdoor temperatures inside. If the outdoor temperature is much colder, the metal frame will become quite cold and water condensates, even ice may form--particularly if the indoor humidity is high. Although wooden frames do not last as long and need more maintenance, they are far better insulators. They are especially good in cold climates. Several manufacturers are offering wood wrapped in plastic sheathing to overcome this problem. Obviously, on skyscrapers where the strength of the frame is of utmost importance, wood cores may not be the answer. Other solutions will have to be pursued.

Window glass conducts temperature changes as easily as metal frames. On a day the outside temperature is 0^{o}, a single pane of normal window glass may be only 17^{o}F on the interior surface. Heated air broadcast by the heating system will get cooled down considerably by freezing window surfaces. That is the reason most commercial and institutional buildings have taken to using thermopane--2 pieces of glass in one frame, separated by an air space. The air trapped between the two window surfaces stops the conduction problem of the glass and frame. In many instances, triple glazed windows are now being specified.

Surprisingly, even double or triple glazed windows do not solve all problems. On a very cold day, the inside surface of a double

glazed window may be only 35°-40°F. Therefore, blinds, screens and/or draperies are decorative means to further insulate windows -- especially if people are expected to sit in close proximity. It should be noted that the warmth manufactured by the human body is attracted to adjacent cold surfaces -- confirming a basic law in physics: molecules travel from areas of high concentration to areas of low concentration. Although the air temperature in a building may be 65°, people seated next to cold windows feel chilled. Thus, a neutral or insulating surface such as a transparent shade is necessary.

Of course, window glass transmits heat as well as cold. A very warm window heats up air conditioned air and wastes more energy dollars in terms of fuel costs than a cold window. It is important to locate heated and air conditioned air vents in such a way that the "conditioned" air does not hit the window surface first, but is rather pointed towards the interior of the building. Sometimes this is not possible, first because most systems run around the periphery of a building, and secondly, particularly in those buildings using floor to ceiling glass, the air conditioning and heating ducts or pipes run against the glass. After all, the first priority of any heating/cooling system is to take care of the area of greatest outside air infiltration and that is the periphery of the building. Here, the ducts or pipes should be insulated, and if they are less than 3-½ feet from the floor, or more than 6-½ high, the adjacent window areas may be blocked with decorative insulating materials. People will still have a view

out of doors, because the normal viewing range of the windows will not be blocked.

On the other hand, in many cases window treatments are hung incorrectly; they capture the "conditioned" air. Draperies, blinds and screens are hung in such a way that the heated or cooled air coming out of adjacent vents is caught between the window treatment and the glass. Great savings in fuel costs can be effected by a little bit of common sense rearrangement.

Another difficulty caused by conduction is the transfer through concrete floors of cold temperature. This happens quite often to employees whose offices are located in basement areas of buildings constructed slab on grade -- the concrete, in other words, rests directly on the dirt, and the dirt may get quite cold on a freezing day. One of the best methods to allieviate the trouble is to build a false floor several inches above the first one so that an air space is created between the two. Carpeting then is placed upon the false floor as added insulation. For small facilities, the technique may be expensive, and therefore, not as popular as simply laying carpeting with an underlayment or foam backing directly onto the concrete floor. Here there is a possibility water condensates may form underneath the carpet. For that reason we suggest synthetic carpets, particularly nylon or polypropylene be used only. Jute as an underlayment should be avoided as well, as natural fibers will have a tendency to rot.

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INSULATION

As indicated, any material will allow the flow of heated or cooled air--even decorative fabrics, or for that matter even books. (Books and files are first rate insulators, but they tend to fall apart after several years of temperature extremes.) For special building insulation purposes, certain materials do better jobs than others. Six inches of fiberglass for instance is as effective an insulator as a brick wall more than eight feet thick. The ability of a material to retard the flow of temperature is measured by the R or Resistence value. The higher the "R" the better the insulating properties. Six inches of fiberglass insulation has an R value of 19, the preferred insulation for ordinary house roof construction.

R-values are additive. Two batts of insulation each rated R-19 yield R-38 together. Therefore, in adding up the R-value of, say, the roof of the building, all componenets have to be taken into consideration: the sub-roof, the insulation and the roofing material. An uninsulated attic in an old wooden frame building may have an "R" of 4. Adding to that six inches of fiberglass, the total may rise to R-23.

There are four basic types of insulation:

1. Batts and blankets. Included here are fiberglass or mineral wool made in standard thicknesses, generally yielding total "R" values of 11, 13, 19 and 22. The varying widths are

meant to fit between wall studs and floor joists. Most people are familiar with this type of insulation because it is the most common for home use. It is also the most common on the market.

2. Loose fill. Cellulose, mineral wool, perlite, fiberglass and vermiculite can be bought as loose fill. Cellulose was fairly common years ago in all sorts of buildings, but today is avoided because of the extreme fire hazard; it is made out of reprocessed paper. Loose fill can be poured or blown into place behind finished walls, although it can be used for new construction also. Unfortunately, it may settle in time, thus lowering the R-value substantially.

3. Foam. Urea formaldehyde is the chemical used. It is suitable basically for use behind finished walls only. It is not economically competitive for new building with other forms of insulation. And it has some serious drawbacks: the foam can deteriorate under the effects of high temperature and high humidity. Proper installation is essential as the chemicals must be mixed with care before application. Then too, the temperature for application is within a very constricted range. Injuction holes must be left open to allow water to evaporate and the foam to cure. Care must be taken in the choice of the contractor and we suggest the work be guaranteed with a firm contract.

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4. Plastic Foam Boards. Urethane, polystyrene and beadboard are several types of insulation boards on the market. They are used as exterior sheathing or to cover finished walls. They are quite easy to apply as they are rigid, but they are combustible and, therefore, must be covered with fire retardant material. Some building codes may ban their use, even on commercial or institutional buildings unless they are covered with fire retardant materials. They are the favored insulation for new buildings.

The enemy of insulation is water. Nearly all insulation is applied with a vapor barrier -- a sheet of foil, plastic or treated paper facing inside the building to prevent moisture condensation which could soak the insulation and lower the R-value. Too much moisture causes construction elements such as studs, joists, and sheathing to rust or rot. Exterior paint can blister if too much water gets underneath. Therefore, besides a vapor barrier, it is often important to allow moisture to vent.

The reciprocal of R-value is "U", or the coefficient of heat transmission. Here, the lower the "U" factor, the less the transmission. While most insulating materials are explained in terms of R-values, building materials are explained in terms of their "U" factor. An 8" thick masonry wall has a "U" of about .70 -- in other words, it transmits changes in temperatures with ease (although, as we explained, this transmission may take time, perhaps 8-10-12 hours). But the same wall covered by metal lath and plaster inside of which flexible insulation has been placed will

have a "U" of .23. Wood siding covered by ½" gypsum sheathing onto which metal lath and plaster is placed as an interior finish has a "U" of .33. The same wood siding sheathed by 1" thick insulating board with an interior finish of 1"insulating board and plaster has a "U" of .12. Here, then, is confirmation that wood is a better insulator than masonry, brick or stone. That's because wood is less dense and it's cellular structure is made up of many pockets of air.

However, masonry, brick or stone construction is more durable and certainly more fireproof than wood. For that reason, they are the preferred materials for commercial and institutional buildings -- although there are many smaller facilities that are housed in wooded frame structures. Techniques have been developed to make masonry, brick or stone as insulating as wood, and almost all of these techniques incorporate insulating materials as well as pockets of air within the basic construction. For example, 8" of hollow concrete block made of light weight aggregate has a "U" of .36. By adding a 1" furring space filled with insulation and finished with metal, lath and plaster, the "U" drops to .18. Even better insulation can be afforded by other techniques to drop the "U" to .12.

At this juncture it is logical to discuss how much insulation is enough -- but as buildings vary from one climate to another, and standards also vary, there are just too many parts to cover. Let it suffice to say that there are 8 basic heat insulating zones in

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this country, ranging from mild climates to very cold climates.* There is also one zone in which it is unnecessary to insulate for heating purposes at all. For cooling, there are only three basic zones. We suggest that for facilities in particular areas, standards either supplied by local code or the Department of Energy be used.

R-VALUE FOR EQUIVALENT 1" THICKNESS OF INSULATING MATERIALS**

	R-Value
Urethane Sheathing (Isocyanate and Isocyanurate)	R-8.0
Extruded Plystyene Foam Board	R-5.0
Urea Formaldehyde	R-4.8
Expanded Polystyrene Foam Board	R-3.9
Cellulose	R-3.7+
Mineral Fibers	R-3.3+
Glass Fiber Batts	R-3.2+

** Information received from the Mobay Chemical Corporation, Polyurethane Division, Pittsburgh, Pa., 15205.

+ These three insulation materials are usually applied in thicknesses greater than 1". The rigid boards may be bought in thicknesses larger than 1", but such is not always the case. Thus, comparing the two groups against the other may be like comparing apples and bananas.

ELECTRICITY

Up to this point, we have been referring to cold climates and their problems of insulation, but it is far more expensive to heat, cool

*For solar heating systems there are at least 12 climatic zones.

and ventilate a building in Houston than the exact same size facility in Minneapolis. The reason is that Houston depends upon air conditioning most of the year -- air conditioning which uses electricity. Minneapolis depends upon heating, using much more economical fuels as oil and gas.

ESTIMATED ANNUAL HOURS OF OPERATION FOR PROPERLY SIZED AIR CONDITIONING EQUIPMENT IN TYPICAL CITIES DURING NORMAL COOLING SEASON*

CITY	HOURS
Atlanta, Georgia	750
Boston, Massachusetts	200
Chicago, Illinois	400
Cleveland, Ohio	450
Dallas, Texas	1,400
Fresno, California	900
Jacksonville, Florida	1,600
Minneapolis, Minnesota	350
New Orleans, Louisiana	1,500
New York, New York	350
St. Louis, Missouri	1,000
Washington, D.C.	800

Electricity is the most expensive form of regularly used energy, far more expensive than oil and gas. The major reason for that expense is that there's a great deal of loss of energy inherent in electrical transmission. Electricity generated somewhere else is transformed, stepped up and then transmitted on long lines to its ultimate destination where it's stepped down and finally transformed once again. During that transforation, transmission and final transformation, a great deal of electricity is lost. The line of transmission and distribution alone accounts for 10%. Out

*From ASHRAE Guide and Data Book - Systems American Society of Heating, Refrigerating and Air Conditioning Engineers.

of the original lump of coal mined, only about 3% of it ends up in the outlet available for a workstation.

Obviously, then, except in instances where electricity is especially cheap-- at locations where the majority of electricity comes from hydroelectric power and other "free" sources -- or where other types of fuel are difficult to procure (in isolated areas or places where snows are high), electric heat should be avoided. Other forms should be used instead. But air conditioning systems are dependant upon electrical energy and because of this management should pay a great deal of attention to keeping their facilities cool in the summer, especially for those located in warmer climates. Unfortunately, the reverse is easier to do. Cold drafts make themselves felt immediately. Part of the reason is that there is such a difference on a really cold day between the inside and outside temperatures. That difference may be 70°F or more. On the other hand, warm drafts are less noticeable. The difference between inside and outside temperatures may be only 15°F. (To test this, put a hand near a known air leak on a cold day. The inflow of cold air is immediately noticeable. Try the same thing in the summer. The inflow is less apparent, and in some cases, not noticeable at all.)

Some corporations and institutions buy individual air conditioning systems and some buy central systems. The difference usually depends upon the size of the facility. On the whole, the central systems are more efficient, but for the smaller facility, they

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are too expensive. When buying individual units the EER or energy efficiency ratio is of utmost importance. The EER is a measure of the amount of cooling an air conditioner can accomplish relative to the amount of electricity it uses. Air conditioners with the same cooling capacity (as measured in BTU's -- British Thermal Units -- per hour) may vary greatly in efficiency. Some use more electricity to achieve the same cooling. The higher the EER, the more efficient the air conditioner. For example, 7,500 to 8,500 BTU per hour 115 volt window models may have an EER range from 5.4 to 9.9. The more effective models -- those near 9.9 -- are almost twice as efficient as the least effective.

KEEPING COOL

Besides buying equipment wisely, it is important also to plan a new building well. One of the easiest methods to effect both warm and cold climate energy conservation is to orient the facility so that the major facades face north-south rather than east-west. Such buildings use one-third less electricity to run cooling equipment than one facing directly into the paths of the morning and afternoon sun. This is especially important for facilities located in warm areas of the country. By the way, the same facility also tends to be warmer in the winter. On the southern exposure, the angle of the sun is high overhead in the summer, and the same sun is low in the sky in the winter. Shaded by the roof during the warm seasons, and shining directly through windows in cold ones, the sun helps maintain the indoor temperature most of the year around. In warm climates, buildings are designed

with overhanging roof lines or columnades angled in the right directions. Buildings in warm areas need shaded walkways to encourage cool breezes and protect exterior surfaces.

Another method of keeping cool is to avoid large expanses of glass, particularly on western exposures. Western exposures suffer the worst heat gain. As the sun moves across the sky, no matter what time of the year, the angle becomes very low in the late afternoon, during the hottest period of the day, shining directly into west facing windows -- at least into those not protected by sun-screens, reflective glass or foilage. The same thing occurs in the early morning when the angle of the sun is quite low, just after dawn. But at that time few buildings are open, and the heat outside has only begun to build up. Therefore, the eastern exposure is of less importance than the west when talking about heat, but obviously can be a problem several weeks each year.

Reflective glass is one way to reduce solar heat gain. Placed on the worst exposures, or for that matter, on all exposures, it does a fine job of preventing the heat or the reflected heat of the sun from entering the building. But a word to the wise: reflective glass is decidedly not beneficial in extremely cold climates. As a matter of fact, it is even questionable if it is beneficial in climates where there are more than 200 days a year in which heat is required and perhaps another 60 to 90 days in which the outside temperature is comfortable. It prevents much needed solar heat from getting inside, when the interior

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needs all the help it can get to maintain comfortable temperatures.

Some energy conservationists believe that there is nothing better than a deciduous tree, especially next to a western exposure. In the summer, the leaves of a deciduous tree are in full foilage, shading the facility, while in the winter, when the facility requires heat, the tree is without leaves, allowing the full force of the sun to shine on the structure. If trees are not possible, then some shrubbery should be used close to the building.

Another favorite of energy conservationists are operating windows. Many architects and engineers do not like operating windows. Neither do office managers. Such windows are considered not as attractive as fixed glass, then too, they cost more than fixed glass, and they do tend to form cracks or open spaces in areas where the windows meet the frame or the wall. There's more maintenance on an operable window than on one that is permanently shut.

But in a study of 86 high rise office buildings in New York City, it was found that those built between 1950 and 1955 averaged only half the energy consumption as those built between 1965-1970. One of the major reasons was the amount of sealed window glass in the newer buildings as opposed to the older ones, forcing complete dependence upon mechanical means to heat, cool and ventilate interior spaces. Sealed structures -- for the most part -- are more energy hungry than their older unsealed cousins.

We find that this too great dependence upon mechanical means has vast implications. In this day and age the weakest link is the

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availability of electricity. Without it, everything comes to a halt. The computers come to a halt. The lights go out. Even oil burners fail; most are electrically fired. Think of the building with sealed windows in a hot climate in the summer when the power goes out...albeit only temporarily. If it's hot out of doors, it's worse inside. Not only do people suffer, but machines do as well. Under particularly warm conditions, the inner working of computer terminals stick together, while some fancier telephone systems have been known to catch on fire! (In 3 minutes after the power failed in New York City that hot summer's day, quite a few private systems caught fire without the help of the rioters!) Then, too, magnetic tape, floppy disks and microfilm melt, ruining precious records.

VENTILATION

As far as mechanical ventilation is concerned, Richard Stein, a noted energy expert, determined that 52% of all energy used by the school system in a major northern city was used for space heating and 2/3 of that energy was required to heat outside replacement air made necessary because of ventilation requirements and/or codes.

A local code may require an air change of 15 cubic feet per minute per occupant in a sealed building. The engineer designing the building may design a ventilation system with capacity to handle only the maximum number of occupants. In other words, the ventilation system may change on a basis of 1000 people

when only 200 may be in the building at any given moment -- except under very special circumstances. Obviously, then, energy waste will be the result. A simple solution is to fit the mechanical system with several different fan speeds that can vary depending upon the conditions.

Then, too, it's important to know exactly where the heated or cooled air is flowing. We cited the common incident in which "conditioned" air is trapped by window treatments. But there are even more common incidents where people place desks, couches, bookstacks and other large objects against walls without checking to see what they are blocking. Vents or radiators may be shut off. Cooled or heated air trapped between furnishings and walls does little to make the interior spaces comfortable.

ENERGY AUDIT

It is important that institutions and corporations audit their buildings' energy use on a regular basis. When correctly carried out by an architect, electrical or mechanical engineer, or special consultant, the management can find out how much money is being spent on fuel and energy the year around on a square foot basis, and how much should be spent by like buildings in the same geographical area. (These latter figures are available from standard sources. The local utilities, for example, often have such figures.)

In certain circumstances, an energy audit can point out areas in which no special capital outlay is required to upgrade energy

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use: changing filters, regularly turning off lights, shutting down machines when not in use, and resetting thermostats. Electric light generation, for example, accounts for about 45%-50% of a facility's energy use. Anything that can be done to cut usage will substantially save the facility money. Dirt blocking the combustion in the furnace is another way energy is lost. Good warmth escapes up the flue in the form of soot. If the building used forced air, it's often easy to tell if this is happening; dirt forms around vents and on ceiling tile near vents. The furnace, the ducts and the vents should be cleaned. But if the building depends upon a steam heat system, the only noticeable thing may be a strange rumble emanating from the furnace, a vibration in the radiator, or soot blowing out of the flue on the roof. A good ear or a quick eye is necessary to catch the problem. Air conditioning condensors also have to be cleaned on a regular basis otherwise they tend to function poorly.

An even more common problem is the loss of heat or cooled air through uninsulated pipes and ducts. Usually there is a contract for keeping the existing HVAC (heating/ventilating/air conditioning) system clean, but no contract to spot the inefficiencies which that same system contains. All too often uninsulated pipes run through unheated areas -- basement crawl spaces and even parking garages. Hot water pipes tend to be uninsulated more than most. But heated or cooled air from the HVAC system lost directly through pipes or duct walls via conductions and leaks around connections finds its way into all sorts of unused nooks and crannies -- inside walls,

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under floors, in the plenum above the false ceiling and even in closets. Many people seem to be under the impression that this unattached warmth or cold is beneficial, that it lingers in the facility, keeping temperatures within comfortable ranges. But the fact is that generally the "conditioned" air dissipates wherever it comes to rest and, in effect, gets lost. A hot water pipe 1½" in width, transporting water at 160°F, loses 13 million BTU for each ten feet of length per year. This is a very large amount to lose. Methods to keep the "conditioned" air or water where needed can be effected by insulating valves and joints, removing leaks in steam traps and by wrapping pipes or ducts with some insulating fireproof material such as fiberglass.

An energy audit can also spot oversized equipment. Usually installed in buildings because of mistaken engineering, oversized heating and cooling equipment may function at only 15%-30% efficiency. An audit also can point out areas in which thermostats do or do not belong. A thermostat located on a wall on the building's periphery is bound to call for more "conditioned" air year round than the very same thermostat located on an interior wall. That's because it's less insulated from changes in outside temperatures.

Then, too, thermostats located directly across from an entrance door also work harder than one enclosed in an interior room.

If the building is fairly large, it certainly pays to have more than one zone on the HVAC system, so that different rooms can call for different reactions for the system. The cut in energy usage pays for itself in fairly short order.

By the way, in light of the fact that energy supplies are becoming hard to obtain at various times -- especially because of political situations-- it may pay for the building to install dual fuel burners, so that more than one kind of fuel is compatible with the HVAC system, such as oil or gas or oil and coal. (In this relation, a separate solar energy system may be feasible, indeed.)

Besides finding inefficiencies of the mechanical systems, an energy audit can pinpoint other difficulties. In one building, a Coca Cola machine was discovered to be using more energy than three electrical vestibule heaters combined. That's because the cooler was right in front of one of the heaters and needed to cycle on and off constantly to keep the soda pop cool.

In a similar circumstance, a facility in the state of Connecticut saved $25,000 on a $3,000 energy audit in the first year. $25,000 does seem impossible, but in this rather large facility some very silly -- and very normal -- things were awry with the mechanical set-up. Outside the furnace room, for instance, an air conditioning thermostat was found to be in year round operation. Whenever the heat went on in the furnace and the temperature rose, the temperature rose in the adjoining room, triggering the thermostat's operation. The cooling cycle functioned even on the coldest days of the year in this basement room that nobody ever occupied. By eliminating such nonsense, that enormous sum was saved.

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(Here, a computer controlled automated system to run the HVAC and electrical demands would be very helpful. Computer controlled systems began to take hold a number of years ago, soon after the development of the inexpensive microprocessor. In a very short time they have proven themselves, cutting energy usage and boosting operating efficiency of the mechanicals and electric consumption. These systems can be programmed to shift HVAC requirements not only according to the time of the year, but also according to the time of day. Where capacity is available, many can send an electrical message to the water supply to store hot or chilled water during off hours -- at night, for example -- making it available at less cost at peak times. The same system may shift electrical loads in the building avoiding costly electrical power surges (many utilities bill according to peak demand). It may follow the sun with photo-sensors, turning off excess lighting around the periphery of the facility when sunlight flows through the windows. It may control variable fan speeds, according to the number of people passing over the threshold. It may also control lighting in individual rooms, turning on lights as people enter the rooms and turning off lights as they leave. And at the same time, the computerized system can integrate all security installations within the building -- or monitor any electronic installation.)

Some aspects of life cycle costing can also be explained by an energy audit where initial expenditures, energy and operational/maintenance costs are weighed one against the other. Some systems do seem to offer great savings in terms of energy, but their operational or maintenance costs in the short run

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are far too expensive:

	System A	System B
Initial Expenditure	$1,000	$2,000
Energy Cost per year	700	200
Operational/Maintenance Cost per year	100	600

Two systems are weighed one against the other in the above example, and one costs half as much as the other to install, but is far more energy expensive, a fact which will be emphasized by the sales agent. A careful look indicates that Operational/Maintenance costs are cheaper in the less expensive systems. This seems to be a common occurrence today. The surge in energy prices notwithstanding, in certain parts of this country, the cheaper one to buy may be as good a buy. The higher Operational/Maintenance costs indicate either extra service or more personnel time. In other words, without good service the system may malfunction constantly and be down most of the time.

Solar Energy

As the costs of fossil fuel escalates, no discussion of energy would be complete without an examination of solar energy. Proponents view solar energy as the quintessential "free source" to provide heat in the winter and air conditioning in the summer. At this writing, there are several well known solar buildings around and more on the way. The United States government as well as private industry is interested in developing "eternal"

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solar panels or cells. The majority of installations tend to be in private residences, although more and more corporations and institutions have been utilizing some forms of solar installation.

The most common solar systems have collectors placed on roofs in a position to catch maximum sunlight, although collectors can be erected in backyards at equally suitable angles, or even attached to walls. It is important that the collectors are positioned to catch as much solar radiation as possible, but at the same time -- if they contain liquids -- they are pitched properly so that the liquids will have a positive flow within the collectors.

Actually, there are three types of collectors: photovoltaic, air and liquid. The photovoltaic cells form electrical currents upon contact with the sun. These cells hold great promise, although those that exist today appear very weak in terms of electrical generation. In the past several months there are promises from the press that the ovonic cells --- amorphous semi-conductors-- will be in large scale use in several years. Unfortunately, their application is unknown at this time, and most installations have used either air or liquid collectors.

In the case of an air collector, the captured heat often is stored in a resevoir of stone --nothing more than a large pile of rocks -- in the basement of a building. When needed the heated air is circulated throughout the building in a system almost identical with that of forced air. But more people are familiar with liquid collectors. The most common,

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the flat plate collector consists of five basic parts: a transparent cover plate which may be one or more sheets of glass or plastic, an absorbed plate such as copper or aluminum covered with a blackened surfaces, tubes or fins that circulate the hot water away from the collector's surface, insulation to prevent heat loss, and a container which protects the whole thing. In one variation, the heated water is gravity fed into a very large and heavily insulated cistern in the basement or close by in an underground storage area. When required somewhere in the bulding, the heat is transferred to pipes somewhat similar to a steam heat system.

In any event, the storage of heat can last for several days, but if the heat becomes exhausted, as in the case of several cloudy or cold days, a supplementary source of space heating may have to be put into operation. That's one of the main reasons solar heating must have a back-up system , and for a large facility that back-up system must rely on conventional fuels. In certain cases, two separate and perhaps incompatible systems may be required --although there are systems that can work in tandem.

At this writing the widest application for solar energy is to provide hot water. Easily connected to conventional hot water systems, solar water heaters are quite practical.

If the facility does decide to go ahead to purchase an air or liquid solar system there are several important questions to ask:

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.Durablity -- how long is the system expected to last? What about guarantees or warrantees?

.Leaks --with many pipe junctions, water systems always have the possibilities of leaks. Remember also that roof areas holding collectors may have to be specially supported. Liquids can be very heavy. One flat plate water collector weighs about 200 pounds. A sagging roof can cause even the finest collectors to leak.

.Corrosion -- metals such as cooper, steel or aluminum may be subject to corrosion. This shortens the life span of a system, and worse, could cause a health hazard. Inhibitors must be maintained.

.Weatherproofing -- how well is the system protected from freezing or overheating? Is anti-freeze necessary? Even in a hot-dry climate a freak cold wave could cause major damage. Then, too, there have been complaints that the black paint at the bottom of the boxes have boiled off from too much heat, making the collectors inoperable.

.Insulation --with ducts, pipes and collectors, adequate insulation inside and out must be installed.

.Ease of repair -- who fixes it if something goes wrong? In fact, is the system installed with repair in mind. Collectors, pipes, cisterns or resevoirs installed in inaccessible places cause great difficulty when things go wrong. And are parts obtainable easily? Are they obtainable locally?

.The view -- collectors are put on the south side of the building

where the sun is all day long. Is that where the view is as well? Many collectors usually take up the entire south wall -- although windows are possible if planned carefully.

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* Highly recommended.

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